NUCLEAR SCIENCE ABSTRACTS

Volume 28 Number 2

Abstracts 2089-5085

July 31, 1973

UNITED STATES ATOMIC ENERGY COMMISSION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of USAEC and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, AEC's Technical Progress Reviews, AEC-sponsored translations, conference proceedings published by AEC, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of USAEC reports in countries other than the United States are listed on the inside back cover.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ALASKA
College, University of Alaska

ARIZONA
Tucson, University of Arizona

CALIFORNIA
Davis, University of California
Los Angeles, University of California
Santa Barbara, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Columbia, University of Missouri
Kansas City, Linda Hall Library

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library

OHIO (Continued)
Columbus, Ohio State University
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

USAEC reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151.

Volume 28, Number 2, July 31, 1973

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries:

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

Commencing in 1973, *NSA* will be issued in two volumes per calendar year. Volume 27 will consist of 12 regular issues January through June, and Volume 28 will consist of 12 regular issues July through December.

For the two 12-issue volumes, the annual subscription rate is $75.50 for domestic subscribers and $94.50 for foreign subscribers. A single issue costs $3.25 domestic rates or $4.07 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes will be cumulated only for each volume, i.e., on a six-month volume basis.

The annual subscription rate for the two volume indexes is $62.00 for domestic subscribers and $77.50 for foreign subscribers.

The following cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:

Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:

Vols. 5–10, Subjects and Authors (1951–1956), $5.25.

Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.

Vol. 21, Subjects and Authors (1967), $16.00.
Vol. 22, Subjects and Authors (1968), $26.00
Vol. 23, Subjects and Authors (1969), $25.75.
Vol. 24, Subjects and Authors (1970), $22.50.
Vol. 24, Authors (1970), Suppl., $2.00.
Vol. 25, Subjects and Authors (1971), $27.50.
Vol. 26, Subjects and Authors (1972), $37.75.

Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.
Cumulative Report Number Index, Vols. 21–26, $9.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume except report number indexes which will be cumulated on a calendar year basis every two volumes. Multivolume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summary below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

DIENSTBIER, Z., Effect of para-aminomethylbenzoic acid on the post-irradiation disturbance of haemocoagulation in dogs after whole-body exposure to 600 R, 27:20122
DIERCKX, R., Determination of the fast neutron spectrum at the L54 reactor core center, 27:21880
DIETZEL, H., HEOS 2 and HELIOS micrometeoroid experiments, 27:20588

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

ACCELERATOR FACILITIES/DESIGN
  Design of a neutron therapy facility for a 30-inch cyclotron, 27:25413
ACETONE/RADIOLYSIS
  Pulse radiolysis of alkyl ketones, 27:24388
  Radiothermoluminescence of aliphatic ketones (Gamma radiation), 27:24389
AEROSOL GENERATORS/OPERATION
  Operating characteristics of two compressed air nebulizers used in inhalation experiments, 27:24522 (LF--45)

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

21102 (ORNL-4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. **(Oak Ridge National Lab., Tenn).** Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
  Gamma-ray production due to neutron interactions with copper for incident neutron energies between 1.0 and 20 MeV: tabulated differential cross sections, 27:21102 (ORNL-4846)

Report Numbers

Technical report literature is also indexed by report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

ORNL-		
4811	**27-21462**	**Dep. NTIS, 133p.**
4840	**27-19984**	**Dep. NTIS, 8p.**
4846	**27-21102**	**Dep. NTIS $4.00, 44p.**
ORNL-EIS-		
73-52(Vol. 1)(No.2)	**27-21978**	**Dep. NTIS, 13p.**
ORNL-NSF-EP-		
31	**27-22013**	**Dep. NTIS, 87p.**
32	**27-22014**	**Dep. NTIS, 83p.**
33	**27-22015**	**Dep. NTIS, 97p.**
34	**27-22016**	**Dep. NTIS, 89p.**
35	**27-22017**	**Dep. NTIS, 98p.**

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 28, Number 2, July 31, 1973

Category	Page
CHEMISTRY	197
Analytical and Separations Chemistry	197
Activation and Nuclear Reaction Procedures	197
Chemical and Spectral Procedures	203
Radiometric and Radiochemical Procedures	208
Separation Procedures	210
Inorganic, Organic, and Physical Chemistry	214
Chemical and Physicochemical Properties	214
Isotope Effects	215
Isotope Exchange and Isotope Separation	217
Feed Materials Processing	219
Radiation Chemistry	219
Radiochemistry and Nuclear Chemistry	225
Hot-Atom Chemistry	226
Properties of Radioactive Materials	226
Radioactive Waste Treatment	231
Radioisotope Production	233
Reactor Fuel Reprocessing	234
ENGINEERING	236
Energy Conversion	236
Facilities and Equipment	237
Heat Transfer and Fluid Flow	238
Materials Testing	239
Nuclear Explosions	241
Protective Structures and Equipment	242
Safety Engineering	242
Vacuum Engineering	242
ENVIRONMENTAL AND EARTH SCIENCES	243
Minerals and Ores	243
Radioactive Effluents	244
Radioactivity Monitoring and Transport	246
Atmosphere	247
Soil	248
Water	248
Ecosystems and Food Cycles	249
Radiometric Techniques	249
Site Surveys	250
Thermal Effluents	252
Chemical Effluents	253
INSTRUMENTATION	256
Radiation Detection Instruments	256
General Detectors and Monitors	256
Radiation Dosimeters	259
Nuclear Spectroscopic Instrumentation	262
High Energy Physics Instrumentation	264
Radiometric Instruments	265
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	266
Miscellaneous Instruments	267
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	270
Isotope Separation (Industrial)	270
Isotopic Power Sources	270

Category	Page
ISOTOPE AND RADIATION SOURCE TECHNOLOGY (Cont'd.)	
Radiation Sources	270
Design and Fabrication	271
Industrial Uses	271
LIFE SCIENCES	274
Radiation Effects on Biochemicals	274
Radiation Effects on Cells	275
Radiation Effects on Microorganisms	276
Radiation Effects on Plants	278
Radiation Effects on Animals	282
Man	282
Vertebrates	285
Invertebrates	290
Radionuclide Effects (Internal Source)	291
Man	291
Animals	291
Plants	292
Nuclide Kinetics and Toxicology	292
Man	292
Animals	293
New Tracer Techniques	294
MATERIALS	296
Ceramics and Cermets	296
Metals and Alloys	306
Corrosion and Erosion	307
Preparation and Fabrication	309
Properties, Structure, and Phase Studies	312
Radiation Effects	322
Other Materials	325
NUCLEAR MATERIALS AND WASTE MANAGEMENT	335
Accountability and Safeguards	335
Disposal and Storage	338
Handling Equipment and Procedures	339
Transportation	340
PARTICLE ACCELERATORS	342
Design, Development, and Operation	342
Auxiliaries and Components	343
Ion Sources and Injection and Extraction Systems	344
Ion Optics and Field Calculations	345
Storage Rings	345
Experimental Facilities	346
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	348
Cosmic Radiation	348
Stars	350
Quasi-Stellar, Radio, and X-Ray Sources	354
Solar Phenomena	355
Galaxies	357
Cosmology	358
Planetary Phenomena	359

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ATMOSPHERIC)	362
Auroral and Ionospheric Phenomena	362
Magnetospheric Phenomena	364
PHYSICS (ATOMIC AND MOLECULAR)	366
Beams and Their Reactions	366
Atomic and Molecular Properties	366
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	367
Collision Phenomena	367
Atomic Theory	369
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	371
PHYSICS (HIGH-ENERGY)	372
Particle Interactions and Properties (Experimental)	372
Electromagnetic	372
Weak	373
Strong (Baryon-induced)	373
Strong (Meson-induced)	373
Particle Interactions and Properties (Theoretical)	375
General	375
Electromagnetic	376
Weak	379
Strong (General)	380
Strong (Baryon No. = 0)	381
Strong (Baryon No. = 1)	382
Strong (Baryon No. ≥ 2)	384
Particle Invariance Principles and Symmetries	385
General	385
Applications (Electromagnetic and Weak)	385
Applications (Strong)	385
Scattering Theory	385
PHYSICS (LOW-TEMPERATURE)	388
Superfluidity	388
Superconductivity	388
Equipment and Devices	391
PHYSICS (NUCLEAR)	393
Neutron Interactions with Matter	393
Nuclear Properties and Reactions, $A \leq 5$	394
Nuclear Properties and Reactions, $6 \leq A \leq 19$	396
Nuclear Properties and Reactions, $20 \leq A \leq 38$	399
Nuclear Properties and Reactions, $39 \leq A \leq 58$	400
Nuclear Properties and Reactions, $59 \leq A \leq 89$	402
Nuclear Properties and Reactions, $90 \leq A \leq 149$	404
Nuclear Properties and Reactions, $150 \leq A \leq 189$	407
Nuclear Properties and Reactions, $190 \leq A \leq 219$	408
Nuclear Properties and Reactions, $A \geq 220$	410
Nuclear Theory	412

Category	Page
PHYSICS (PLASMA AND THERMONUCLEAR)	419
Confinement and Heating	419
Diagnostics	421
Kinetics (General)	422
Kinetics (Experimental)	422
Kinetics (Theoretical)	423
Production	423
Stability	424
Thermonuclear Engineering and Equipment	425
Wave Phenomena	427
PHYSICS (RADIATION AND SHIELDING)	429
Radiation Physics	429
Radiation Protection Standards	433
Radiation Source Calibration and Standardization	433
Shielding Calculations and Experiments	434
PHYSICS (THEORETICAL)	436
General	436
Quantum Field Theories	437
Gravitation and General Relativity	437
REACTOR TECHNOLOGY AND REGULATION	439
Power Reactors, Non-Breeding, BWR-Type	439
Power Reactors, Non-Breeding, PWR-Type	440
Power Reactors, Non-Breeding, Graphite Moderated	440
Power Reactors, Non-Breeding, Otherwise Moderated	442
Power Reactors, Breeding	443
Research, Test, and Experimental Reactors	447
Production and Materials Testing and Processing Reactors	447
Propulsion and Package Reactors	448
Reactor Safety and Environmental Aspects	448
Reactor Theory and Calculation	452
Reactor Components and Accessories	453
Reactor Fuels	455
Reactor Control Systems	455
Nuclear Power Plant Economics	456
Reactor Fuel Cycle Economics	458
Reactor Licensing and Regulation	458
GENERAL	469
Civilian Defense	469
Energy Utilization and Economics	469
Information Handling	470
Law	470
Management	471
Mathematics and Computers	471
Miscellaneous	474
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-16
SUBJECT INDEX	INDEX-87
REPORT NUMBER INDEX	INDEX-200

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Associate Editors
Everett J. Hoffman
John W. Norris
Lawrence T. Whitehead

Section Editors
M. Catherine Grissom
Robert C. Kelly
Henry D. Raleigh
Charles E. Stuber
Lee M. Thompson

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Sidney F. Lanier

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Evaluators
Thomas S. Chapman
John H. Mitchell
Mary H. Newman

Abstractors
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Helga B. Gerstner
Phyllis C. Hansen
Carolyn D. Houston
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Dora H. Moneyhun
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Jesse W. Rushing
Robert W. Rutkowski
Francis S. Sachs
Lila B. Smith
Polly C. Summers
Helen L. Ward
Kenneth S. Warren
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Frederick E. Marsh

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 28, Number 2 July 31, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

2089 (AECL-4434) CHEMISTRY AND MATERIALS DIVISION. Progress Report, October 1-December 31, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 115p. (PR-CMa-23). Dep. NTIS (U. S. Sales Only) $7.75. AECL $2.50.

Analytical and Separations Chemistry

Refer also to abstracts 2720 and 4528.

2090 NONFERROUS METALLURGY. I. Light Metals: Aluminum, Beryllium, Titanium, and Magnesium. Danchik, R. S. (Aluminum Co. of America, New Kensington, Pa.). Anal. Chem.; 45: No. 5, 113R-128R(Apr 1973).

The fourteenth review on nonferrous metallurgical analysis covers the two year period from September, 1970 through August 1972. The review is limited to analytical methods applied directly to materials of interest in the nonferrous metal industry. (343 references) (DHM)

2091 NONFERROUS METALLURGY. II. Zirconium, Hafnium, Vanadium, Niobium, Tantalum, Chromium, Molybdenum, and Tungsten. Butler, C. C.; Kniseley, R. N. (Ames Lab., IA). Anal. Chem.; 45: No. 5, 129R-150R(Apr 1973).

A review of the literature for methods of analysis of Zr, Hf, V, Nb, Ta, Cr, Mo, and W is presented in which the references are divided by element into the following categories: books and reviews, gravimetric methods, electrometric methods, titrimetric methods, spectrophotometric methods, optical emission spectroscopic methods, flame emission, atomic absorption, and fluorescence methods, x-ray fluorescence and absorption methods, neutron activation and other radiochemical methods. (793 references) (DHM)

2092 WATER ANALYSIS. Fishman, M. J.; Erdmann, D. E. (Geological Survey, Lakewood, Co.). Anal. Chem.; 45: No. 5, 361R-403R(Apr 1973).

A review on methods of water analysis is presented that covers the literature from October, 1970 through September, 1972. The elements considered include alkali metals, alkaline earth metals, Al, Fe, Mn, Cr, Re, Ce, Tl, Cu, Zn, Pb, Cd, Ni, Co, Sn, Hg, Ag, Au, V, Mo, Sc, Sb, Bi, U, rare earths, B, Se, As, P, Si, halides, sulfate, sulfide, nitrate, nitrite, nitrogen compounds, pH, Eh, alkalinity and CO_2, O_2 and other gases, detergents, pesticides herbicides, organics, radioactivity, and isotopic analysis. (697 references) (DHM)

Activation and Nuclear Reaction Procedures

Refer also to abstracts 2645, 3535, and 3536.

2093 (CEA-N-1592) PRELIMINARY TESTS USING A FLUORINE WELL-LOGGING PROBE. Report of the Remiremont Expedition, June 26-30, 1972. Dumesnil, P.; Andrieux, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 20 Nov 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The principles behind the fluorine well-logging technique used are given. The fluorine is converted into ^{16}N by neutrons from an Am-Be source contained in the head of the probe. The detector, a NaI(Tl) scintillator, is positioned 1.2 meters away from the source in the body of the probe. The 6.13 MeV photons emitted by the decaying ^{16}N are detected. Two types of well logging technique are described: a point method and a continuous method. (FR)

2094 (CONF-721010-43) DETERMINATION OF RARE EARTHS IN YTTRIUM OXIDE BY MEANS OF A PRECONCENTRATION TECHNIQUE AND Ge(Li)-GAMMA SPECTROMETRY. Bruijs, P. C. M. N. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands)). 1972. 11p. Dep. NTIS $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Before preconcentration, the Y matrix is separated from the lanthanides by cation and/or anion exchange. The rare earth elements are then concentrated by coprecipitation with 5 mg of Fe as $Fe(OH)_3$ in quartz centrifuge tubes. The dehydrated Fe-REE mixture is then irradiated and counted without any further major manipulations. Ge(Li)-γ spectrometry is used, the ^{59}Fe activity acting as a flux monitor and internal standard. (France)

2095 (CONF-721010-64) HIGH PRECISION NEUTRON ACTIVATION ANALYSIS OF MANGANESE IN ORES AND ALLOYS WITH THE AID OF AN ISOTOPIC NEUTRON SOURCE. Alaerts, L.; Op de Beeck, J. P.; Hoste, J. (Ghent Rijksuniversiteit (Belgium). Institutt Voor Kernwetenschappen). 1972. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The irradiation was carried out using a 1 Curie ^{226}Ra-Be neutron source. Nuclear interferences, neutron selfshielding, and gamma attenuation effects were studied. The experimental procedure is described: preparation of samples and standards (mixture of powdered pyrolusite or ferromanganese and graphite pressed into pellets under a constant pressure of 400 kg/cm^2); counting equipment (NaI(Tl) detector); analysis sequence and iterative calculation procedure. The results obtained from the analysis of 9 pyrolusite and 6 ferromanganese samples are summarized. (FR)

2096 (CONF-721010-65) THERMAL AND EPITHERMAL NEUTRON ACTIVATION ANALYSIS USING THE MONOSTANDARD METHOD. Alian, A.; Born, H. J.; Kim, J. I. (Technische Universitaet, Munich (West Germany). Institut fuer Radiochemie). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Theoretical aspects of epithermal and thermal neutron activation analysis are presented. A classification of the elements into two groups is suggested: elements with relatively low resonance integral values (the irradiation is performed without Cd filter using a reference standard of the same group, thermal cross section values being used for the effective cross sections); elements with relatively high resonance integral values (the irradiation is carried out using a cadmium filter and a reference standard of the same group is used, resonance integral values being used for the effective cross sections). In this way, the sensitivity to changes in the positioning of the irradiation is reduced, the number of determinable elements is increased, and the sensitivity and accuracy are improved. The application of this method to the analysis of 14 elements in the standard rocks BCR-1 (basalt of USNBS) and GR (French standard granite) is discussed. Values determined for the thermal cross sections and resonance integrals of these elements are presented. (FR)

2097 (CONF-721010-66) APPLICATION OF PARTITION CHROMATOGRAPHY TO ACTIVATION ANALYSIS. Alimarin, I. P.; Yakovlev, Yu. V.; Stepanets, O. V. 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A partition chromatography method for separating the elements to be determined is proposed. The method is based on exchange reactions with internal complexes of the metals. The principle of the method is the successive displacement of elements (in substochiometric quantities) from an aqueous solution into an organic phase (in column). The method was used in the determination of a series of impurities (Mn, Zn, Cd, Cu, Ag, Hg, Co and Fe) by activation analysis in Y, Mo, Zr, Nb, and Be. (FR)

2098 (CONF-721010-67) ACTIVATION ANALYSIS OF SUBSTANCES HAVING LARGE NEUTRON CAPTURE CROSS SECTIONS. Alimarin, I. P.; Yakovlev, Yu. V.; Dogadkin, N. N. 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

An activation analysis method for B and Cd was developed, which takes into account the absorption of neutrons by the sample. The concept of the self shielding coefficient for the matrix impurities is introduced; a formula is proposed to calculate the self-shielding coefficients for the impurities. This formula is based on the ratio between the quantities of B and Cd present in the sample to be analyzed. A satisfactory agreement is obtained between theory and calculation. (FR)

2099 (CONF-721010-68) METHOD OF MEASURING THE HALF LIFE OF A RADIOACTIVE SUBSTANCE: APPLICATIONS. Beeler, R.; Balsenc, L.; Laplace, J. (Geneva Univ. (Switzerland)). 1972. 9p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A function describing multichannel measurements is proposed. This function is dependent on 3 parameters: time, half-life, and the initial dead time fraction. Special electronic equipment was developed to measure the latter factor. The half-lives of various elements (Hf, Ag, Se, Na, V, Sc and Al) were measured. Differences in the half-lives of the metal and its salts were established for some of these elements. (FR)

2100 (CONF-721010-69) USE AND AUTOMATION OF MULTIELEMENT SUBSTOICHIOMETRIC EXTRACTION OF METAL CHELATES IN ACTIVATION ANALYSIS. Elek, A. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A solvent extraction method based on the substoichiometric separation principle is presented. The separation conditions are discussed. Automated procedures were developed for the group extraction of mercury and silver dithizonates and of mercury, copper, antimony, and arsenic diethyldithiocarbamates. (auth)

2101 (CONF-721010-70) RADIOGRAPHIC METHODS IN THE ANALYSIS OF B, Li, Ra, U, AND Th IN MINERALS AND ORES. Flerov, G. N.; Berzina, I. G. 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The possibility of employing various types of radiation source in f radiography, (n,α) radiography, and autoradiography is examined in view of determining the spatial distribution of B, Li, Ra, U, and Th and accurately establishing their local and general concentrations in different substances. Results are presented on the applications of such methods to practical geology. (FR)

2102 (CONF-721010-72) PRACTICAL ASPECTS OF NEUTRON ACTIVATION DETERMINATION OF THE PLATINUM METALS. Gijbels, R.; Govaerts, A. (Ghent Rijksuniversiteit (Belgium). Institutt Voor Kernwetenschappen). 1972. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Triple gamma coincidence counting of ^{192}Ir allowed Ir to be determined by instrumental neutron activation analysis down to 1 ppb in ultra-basic rocks and down to 20 ppb in some high furnace slags: the limiting factor for the latter matrix was the presence of ^{124}Sb. Radiochemical neutron activation analysis of the U.S.G.S. standard rocks revealed that the Ir contents are up to three orders of magnitude lower than previously reported, except for the ultra-basic rocks. The factors of merit for several scintillation and semiconductor gamma ray detectors were established for the determination of Pd, Pt, and Os using neutron activation. In the case of radiochemically pure sources, a NaI(Tl) wafer was preferred; in the presence of high energy gamma emitters, a Ge(Li) low energy photon detector was superior. (auth)

2103 (CONF-721010-73) ANALYSIS OF PRECISION OF ACTIVATION ANALYSIS METHODS. Heydorn, K.; Noergard, K. (Danish Atomic Energy Commission, Risoe. Research Establishment). 1972. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The precision of an activation analysis method prescribes the estimation of the precision of a single analytical result. The adequacy of these estimates to account for the observed variation between duplicate results from the analysis of different samples and materials is tested by the statistic T, which is shown to be approximated by a chi-squared distribution. Application of this test to the results of determinations manganese in human serum by a method of established precision, led to the detection of airborne pollution of the serum during the sampling process. The subsequent improvement in sampling conditions was shown to give not only increased precision, but also improved accuracy of the results. (auth)

2104 (CONF-721010-74) APPLICATION OF COMPUTERS TO THE CHOICE OF AN OPTIMUM ACTIVATION ANALYSIS METHOD AND TO THE AUTOMATIC PROCESSING OF THE DATA. Ivanov, I. N. 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The computerized choice of an optimum activation analysis method and the appropriate processing of the data obtained are discussed. The programs employed to select the radiation source and the recording equipment and to optimize the analysis time are given. The various methods used to interpret the γ spectra are presented. The complex utilization of the programs in a series of cases enabled the subsequent determination of analysis parameters, and optimized operating conditions. (France)

2105 (CONF-721010-75) QUALITATIVE AND QUANTITATIVE INTERPRETATION OF γ-RAY SPECTRA IN ACTIVATION ANALYSIS. Korthoven, P. J. M. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A method is presented for the automatic identification of the elements present in a sample and the calculation of the corresponding concentrations from the energies and peak areas determined by a spectrum analysis computer program. A preliminary interpretation list is produced in which for each peak in the spectrum, the possible isotopes are given. This list is based only on the γ-ray energies and half lives of the isotopes. A careful analysis of this list yields groups of identified elements at four different significance levels. The determination of the corresponding concentrations is based on the single separator method. The procedure is included in an automatic activation system but can also be used separately. (auth)

2106 (CONF-721010-76) DETERMINATION OF Ti, V, Zn, AND W USING PROTON ACTIVATION. Krasnov, N. N.; Sevast'yanov, Yu. G.; Konstantinov, I. O.; Vinogradova, V. G.; Malukhin, V. V. 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A proton activation method using 11 MeV protons for the determination of Ti in Sc, V in Ti, Zn in Cu, and W in Ta is presented. The experimental data obtained from the yields of ^{48}V, ^{51}Cr, ^{66}Ga, and ^{182}Re are presented together with information on the sensitivity of the analysis. (France)

2107 (CONF-721010-77) ACTIVATION ANALYSIS WITH FAST NEUTRONS USING A CYCLOTRON. Krivan, V.; Muenzel, H. (Max-Planck-Institut fuer Metallforschung, Stuttgart (West Germany); Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A systematic study of activation analysis (using (n,2n), (n,p), and (n,α) reactions) with cyclotron produced neutrons is presented. The detection limits for elements having atomic numbers between 6 and 80 are given. The possibility of optimizing the irradiation conditions by choosing the most suitable neutron spectrum is dis-

cussed. This method of fast neutron activation analysis is compared to neutron activation analysis using a conventional 14 MeV source. (France)

2108 (CONF-721010-79) ACTIVATION ANALYSIS OF PURE MATERIALS USING SHORT HALF-LIFE ISOTOPES. Lobanov, E. M.; Dutov, A. G.; Leushkina, G. V. 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

An industrially applicable nondestructive neutron activation analysis method is described. Isotopes having half-lives between 2 seconds and 20 minutes were used. The sensitivity values envisaged for the analysis of 33 elements are presented. The effect of the instability of the neutron flux on the results of the activation of the elements is discussed together with the measurement errors and the performance required from the electronic spectrometric equipment. (FR)

2109 (CONF-721010-80) INTERFERENCES IN THE DETERMINATION OF TRACE ELEMENTS IN HIGH-PURITY TIN. Maenhaut, W.; Adams, F.; Hoste, J. 1972. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Reactor neutron activation analysis of antimony, indium, and cadmium in high-purity tin is interfered with by nuclear reactions on the tin matrix. The cross sections were determined for a number of interfering reactions. The following results were obtained: $^{122}Sn(n,\gamma)^{123m}Sn$: σ_{th} = 0.145 barn, I = 0.79 barn; $^{112}Sn(n,\gamma)^{113}Sn$: σ_{th} = 0.52 barn, I = 25.4 barn; $^{112}Sn(n,2n)^{111}Sn$: σ_F = 290 microbarn; $^{118}Sn(n,\alpha)^{115}Cd$: σ_F = 0.252 microbarn; $^{114}Sn(n,p)_{114\,ml}In$: σ_F = 42.3 microbarn. (auth)

2110 (CONF-721010-81) DETERMINATION OF RARE EARTHS BY HIGH RESOLUTION X-RAY SPECTROMETRY FOLLOWING NEUTRON ACTIVATION. Mantel, M.; Amiel, S. Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Reactor neutron activation followed by high resolution x-ray spectrometry was applied to the nondestructive quantitative determination of the rare earth elements in naturally occurring materials. The various sources of error as well as the possibilities of minimizing them are discussed. (auth)

2111 (CONF-721010-82) APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE MEASUREMENT OF ISOTOPE ABUNDANCE SHIFTS IN CALCIUM AND POTASSIUM. Moeller, P.; Sastri, C. S. (Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany)). 1972. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A simple method of measuring the isotopic abundance shifts of ^{44}Ca and ^{41}K in low volatility compounds using neutron activation analysis is presented. The extraction and measurement procedures used for the radioactive argon isotopes (^{37}Ar, ^{39}Ar, ^{41}Ar) produced in the (n,α) and (n,p) reactions are also given. The results demonstrate that the accuracy obtained in the measurement of delta ^{44}Ca exceeds that obtained by spectrometric methods; in the case of delta ^{41}K measurements, the accuracy obtained was the same as that obtained with the mass spectrometer. Interfering reactions which yield other rare gases are discussed together with their relative contribution to the error in measuring the delta values. (auth)

2112 (CONF-721010-83) BETA GAMMA COINCIDENCE SPECTROSCOPY OF RADIOCHEMICAL SEPARATED NUCLIDES IN HIGH SENSITIVE NEUTRON ACTIVATION ANALYSIS. Niese, S. (Zentralinstitut fuer Kernforschung, Rossendorf Bei Dresden (East Germany)). 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Beta gamma coincidence spectroscopy is a sensitive measurement technique in reactor neutron activation analysis. A simple counting device with a 4″ × 3″ NaI(Tl) crystal and a 32 mm × 2 mm plastic scintillator is described and the advantage of the $\beta-\gamma$ coincidence technique (which has been successfully applied to the determination of iron and other impurities (Cu, Mn, Au, Cu) in semiconducting silicon) is discussed. (auth)

2113 (CONF-721010-84) PHOTOELECTRIC EFFICIENCY IN THE RECORDING OF γ RADIATION AND THE LIMITS OF DETECTION OF ELEMENTS BY ACTIVATION ANALYSIS USING A Ge(Li) SPECTROMETER. Pelekis, L. L.; Pelekis, Z. Eh.; Taure, I. Ya. 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The photoelectric efficiency of different volume Ge(Li) detectors (3.5, 28 and 45 cm^3) was studied. Values were obtained for the efficiency of the source as a function of the measurement geometry. The limits of detection were established for 30 elements having long half-lives and 38 other elements having short half-lives. (FR)

2114 (CONF-721010-85) DETERMINATION OF SMALL QUANTITIES OF NOBLE METALS BY ACTIVATION ANALYSIS. Rakovskii, Eh. E.; Baevskaya, G. M.; Krylova, T. D.; Kuligin, V. M.; Starozhitskaya, M. I. 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The following metals were extracted using a series of organic reagents: Pt, Pd, Ir and Os. They were obtained in a radiochemically pure form. The effect of the medium and the nature of the solvents used to extract these noble metals was studied. The results obtained were applied to the development of neutron activation analysis methods. (FR)

2115 (CONF-721010-86) ACTIVATION ANALYSIS USING RESONANCE NEUTRONS AND POLARIZED PARTICLES. Shtan, A. S. 1972. 31p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The principles of resonance neutron analysis (RNA) are outlined. The results of studies of the possibilities of increasing the sensitivity of the analysis are presented. Three different RNA methods are described: activation, absorption, and a resonance method depending on the time taken for the neutrons to slow down. The use of polarized neutrons to determine the composition of the substance is considered. (FR)

2116 (CONF-721010-87) RADIOANALYTICAL INVESTIGATION ON RHODIUM EXTRACTION BEHAVIOR WITH TRI-N-BUTYL PHOSPHATE FROM IODIDE SOLUTIONS. Stella, R.; Di Casa, M. (Pavia Univ. (Italy)). 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Radioanalytical techniques were used to investigate the extraction behavior with TBP of rhodium(III) chloride solutions to which a large excess of iodide had been added. Extraction yields and distribution coefficients were determined as a function of the $HClO_4$ or H_2SO_4 content in the aqueous phase. The stripping of rhodium from the organic phase with ammonia solutions was also tested. (auth)

2117 (CONF-721010-88) AUTOMATED CHEMICAL SEPARATIONS IN ROUTINE ACTIVATION ANALYSIS. Tjioe, P. S.; de Goeij, J. J. M.; Houtman, J. P. W. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A separation scheme was successfully developed for arsenic, antimony, cadmium, copper, mercury, selenium, and zinc in view of environmental studies. It is based on a combination of distillation and ion exchange processes. Special attention is paid to prevent interference from bromine and sodium. Additional information about chromium, cobalt, nickel, and tungsten can easily be obtained. Experience gathered with an automated instrument handling fifty samples a week is described. (FR)

2118 (CONF-721010-89) OVERALL INSTRUMENTAL THERMAL NEUTRON ACTIVATION ANALYSIS OF HIGH PURITY MATERIALS. Verheijke, M. L.; Verplanke, J. C. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Forschungslaboratorium). 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A more or less routine method for the determination of up to 55 trace elements down to the ppB range is described. Irradiation is carried out in a high thermal neutron flux. Ge(Li) γ spectrometry with large detectors and off-line computerized evaluation of the spectra is then employed. In order to examine the half-life range of the nuclides formed, spectrum measurements are made one hour, one day, one week, and one month after irradiation. Only in the case of highly active long mean life matrices

is the chemical separation of the matrix from its impurities necessary. The computer program is written in ALGOL-60. (auth)

2119 (EURISOTOP-74) USE OF ACTIVATION ANALYSIS BY γ PHOTONS AND CHARGED PARTICLES TO DETERMINE THE OXYGEN CONTENT IN NONFERROUS METALS, PARTICULARLY IN Al, Cu, Pb, AND THEIR ALLOYS, Ti, Zr, Nb, Mo, Ta, Na, Cs, Si, Ge, AND Se. Engelmann, Ch. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1973. 94p. Dep. NTIS (U. S. Sales Only) $6.75.

A review is presented on γ photon and charged particle activation analysis that include, principle of the method, methods of activation, detection sensitivity, influence of impurities and of the matrix, chemical separation methods, methods of determining O_2, Al, Cu, Pb, Ti, Zr, Nb, Mo, Ta, Na, Cs, Si, Ge, and Se, industrial methods of determining oxygen, and method for determining surface oxygen. (78 references) (DHM)

2120 (FRNC-CONF-71) ANALYSIS OF THE CHEMICAL COMPOSITION OF FLUID INCLUSIONS BY NEUTRON ACTIVATION. Deschamps, N.; Sabouraud, C.; Bourrelly, I. N.; Touray, J. C.; Treuil, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; See code: 6514000 Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire; Orleans Univ. (France)). 1972. 4p. (In French). (CONF-721069-43). Dep. NTIS (U. S. Sales Only) $3.00.

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The measurement of Cl/Br ratio in fluid inclusions of marine gypsums is described. The samples are irradiated in a 7×10^{12} n cm^2 s^{-1} flux and the chlorine and bromine are subsequently separated. The emitted γ radiation is measured using a NaI(Tl) detector connected to a multichannel amplitude selector. (auth)

2121 (FRNC-CONF-72) NEUTRON ACTIVATION ANALYSIS OF V, Cr, Hf, Zr, Tl, Rb, AND Cs IN CLAYS, ZIRCONS, AND FELDSPARS. Jaffrezic, H.; Decarreau, A.; Carbonnel, J. P.; Deschamps, N. (Centre National de la Recherche Scientifique, Nancy (France). Centre de Recherches Petrographiques et Geochimiques; Paris Univ., Orsay (France); Centre National de la Recherche Scientifique, Paris (France); Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 4p. (In French). (CONF-721069-7). Dep. NTIS (U. S. Sales Only).

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Examples of the applications of neutron activation analysis to geochemical problems are given: distribution of rare alkaline elements and thallium in feldspars; measurement of the Zr/Hf ratio in zircons; and determination of V in clays. (France)

2122 (FRNC-CONF-77) ACTIVATION ANALYSIS AT L'ECOLE DES MINES (SAINT-ETIENNE): APPLICATION TO THE STUDY OF VERY HIGH PURITY Fe. Lesbats, A.; Tardy, M. R. (Ecole Nationale Superieure des Mines, Saint-Etienne (France)). 1972. 8p. (In French). (CONF-721069-10). Dep. NTIS (U. S. Sales Only).

From international colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Research undertaken on very-high-purity metals is considered. It is shown how a laboratory situated far from Atomic Centers can utilize radioactivation analysis. The principal application considered is that of very-high-purity Fe. An original and rapid method of extraction utilizing butyl acetate is presented. The method enables a selective and quantitative separation of the Fe matrix. (France)

2123 (KFK-1767) DETERMINATION OF RARE EARTHS IN STANDARDIZED GLASSES BY MEANS OF NEUTRON ACTIVATION ANALYSIS. Ruf, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Feb 1973. 24p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

Micro- and submicrogram-amounts of rare earth elements were determined in standardized glasses by neutron activation analysis. After decomposition of the irradiated samples using a mixture of sulfuric acid and hydrofluoric acid and after volatilization of silicon, rare earth elements were separated commonly from other glass components by hydroxide and fluoride precipitations. The isolation of single lanthanides was effected on ion-exchange columns of Dowex 50 with α-hydroxyisobutyric acid as eluant using the gradient elution technique. The purpose of a modification of the known method by subdivision of the total pH-range into subranges intended the quickest possible elution of short-lived activities, whereby the separation of adjacent elements was excellent. The analytical results of this work are compared with those of other laboratories. (GF)

2124 ACTIVATION ANALYSIS OF ALUMINUM FROM WATER EXTRACT OF SOIL. Misra, U. K.; Graham, E. R.; Upchurch, W. J.; McKown, D. M. (Univ. of Missouri, Columbia). Soil Sci. Soc. Amer., Proc.; 37: No. 2, 193-196(1973).

Determination of low-level Al in soil water extracts or lysimeter leachings requires a method extremely sensitive in ppB range. $^{27}_{13}Al(n,\gamma)\,^{28}_{13}Al$ is rapid and convenient because it has a high cross section and a short half life. ^{28}Al may also be produced by $^{28}_{14}Si(n,p)\,^{28}_{13}Al$. Hence a correction must be made by determining Si colorimetrically and finding the counts due to Si from a standard graph of Si concentration vs. cpm in the channels used for Al. ^{38}Cl was the major interfering nuclide. Chloride was removed by leaching the extracts through anion exchange resin saturated with NO_3. Manganese-56 becomes an interfering nuclide in samples with high Mn content. Manganese corrections may be made by spectrum stripping. Aluminum standard solution was passed through an anion exchanger. Silica and aluminum standard solutions and the sample extracts were then activated for 1 min. The samples were allowed to decay for 3 min. Then 1 ml was counted using a NaI (Tl) detector and a multichannel gamma ray analyzer. The Al content of the samples was determined and it appears that a coefficient of variation near 3.0% would be obtainable on samples down to 0.1 ppM. (auth)

2125 ULTRAPURITY IN TRACE ANALYSIS. Mitchell, J. W. (Bell Telephone Labs., Inc., Murray Hill, N. J.). Anal. Chem.; 45: No. 6, 492A-496A; 498A; 500A(May 1973).

Methods for the preparation or practical characterization of ultrapure materials are reviewed. Recent advances in methods of trace analysis are presented, major obstacles to extending the limits for determining trace elements are discussed, and developments required in the future are treated. Techniques potentially applicable for accurate determinations of submicrogram amounts of trace elements are tabulated. Among them are neutron activation, substoichiometric radioisotope dilution, stable isotope dilution, nuclear track counting, anodic stripping voltammetry, electron capture gas chromatography, x-ray fluorescence techniques, and polarography. (62 references) (JGB)

2126 ON-STREAM ANALYSIS. Larson, J. G.; Orange, J. M. (to Gulf Research and Development Co.). U. S. Patent 3,723,732. 27 Mar 1973. Filed Date 24 May 1971. 10p.

The preferred form of the invention comprises a relatively small ^{252}Cf radioactive source positioned within a coil irradiator, specifically for the detection of vanadium in hydrocarbon streams. The sample flow is from the outside towards the inside in the irradiator, and in the opposite direction in the detection means coil, so that decay counting efficiency is enhanced. (Official Gazette)

2127 DETERMINATION OF MOLYBDENUM IN SEA WATER BY HOT GRAPHITE ATOMIC ABSORPTION SPECTROMETRY AFTER CONCENTRATION ON P-AMINOBENZYLCELLULOSE OR CHITOSAN. Muzzarelli, R. A. A. (Univ., Bologna); Rocchetti, R. Anal. Chim. Acta; 64: No. 3, 371-379(May 1973).

A comparative study of the chelating ability of chitosan, p-aminobenzylcellulose, and diethylaminoethylcellulose for a number of metal ions is discussed. Results of the separation of Mo from fifteen other ions including UO_2^{2+} are reported. There is a strong interaction between molybdenum and these polymers in thiocyanate solutions and in sea water. By combining the sensitivity of graphite-furnace atomic absorption spectrometry with the efficiency of the selective collection of molybdenum on p-aminobenzylcellulose or chitosan at pH 2.5, it was possible to determine molybdenum in as little as 50 ml of sea water. (auth)

2128 NONDESTRUCTIVE DETERMINATION OF TRACE IMPURITIES IN IRON BY THERMAL NEUTRON ACTIVATION ANALYSIS WITH LONG LIVED ISOTOPES. De Wispelaere, C.; Op de Beeck, J. P.; Hoste, J. (Univ., Ghent). Anal. Chim. Acta; 64: No. 3, 321-332(May 1973).

A method is proposed for the instrumental determination of Co, Cu, W, As, Ga, and Sb in a pure iron matrix. Semiconductor detectors with high resolving power, automatic data collection and completely computerized data interpretation were used. A method of preparing and testing composite multi-element standards is described in detail. (auth)

2129 PHOTOACTIVATION ANALYSIS OF GEOLOGICAL SAMPLES WITH 25-MeV BETATRON. Galatanu, V. (Inst. for

Atomic Physics, Bucharest); Grecescu, M.; Radovici, G. pp 319-329 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The advantages of photoactivation analysis over neutron activation analysis for geological and ore samples are discussed. The experimental procedures, elements determined (Rb, Sr, Zr, Nb, Sn, Cs, and Ta), and the interfering elements are given. (ERB)

2130 SEPARATION OF Na, K, AND P BY MEANS OF INORGANIC SEPARATORS IN THE NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL MATERIAL. Toeroek, G.; Schelenz, R.; Fischer, E.; Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Z. Anal. Chem.; 263: No. 2, 110-115(1973). (In German).

Two sorption processes for removal of the matrix activity of neutron activated biological samples were investigated in detail. "Hydrated Antimony Pentoxide" (HAP), prepared by various methods, was applied to remove the ^{24}Na, while zirconium phosphate (ZP) was used for the removal of ^{32}P. Commercially available (S.E.R.A.I.) titanium phosphate (TiP) was applied for the retention of ^{42}K. The optimal conditions for preparation and application of these substances were determined by investigation of the sorption parameters and of some physico-chemical properties. Applying the sorption materials HAP, ZP, and TiP under the chosen working conditions, none of the three disturbing activities could be detected in neutron-irradiated potato samples. A semiautomatic apparatus was constructed for the dissolution and chemical processing of the irradiated materials, the main parts of which are the following: distillation apparatus, sorption column, ion-exchange column, gradient-elution system, electropneumatical valves, and a fraction collector. The entire chemical processing is carried out by remote control, the time requirement is about 7h. (GF)

2131 INFLUENCE OF SEASON VARIATION FOR GOLD DETERMINATION IN PLANTS BY NEUTRON ACTIVATION ANALYSIS. Schiller, P.; Cook, G. B.; Kitzinger-Skalova, A.; Woelfl, E. (International Atomic Energy Agency, Seibersdorf, Austria). Radiochem. Radioanal. Lett.; 13: No. 5-6, 283-286 (30 Apr 1973).

The influence of the season variation for gold determination in plants by neutron activation analysis was studied. (auth)

2132 OPTIMUM SAMPLE SHAPE FOR 14-MeV NEUTRON ACTIVATION ANALYSIS. Taczanowski, S. (Inst. of Nuclear Techniques, Krakow). J. Radioanal. Chem.; 12: No. 2, 535-542 (Dec 1972).

Based on the criteria of the maximum induced activity, the problem of the optimum sample shape was analyzed for a given volume of sample. Its shape was assumed to be cylindrical and the optimum values for the height-to-diameter ratio (presented in the included tables) were calculated under various circumstances. Coaxial and perpendicular sample-target irradiation geometries were considered. (auth)

2133 DETERMINATION OF SILICON DIOXIDE IN IRON AND STEEL-MAKING SLAGS AND FLUORSPARS BY 14-MeV NEUTRON ACTIVATION AND HIGH-RESOLUTION GAMMA-RAY SPECTROMETRY. Chiba, M.; Inoue, Y.; Tajiri, Y. (National Research Inst. for Metals, Tokyo). J. Radioanal. Chem.; 12: No. 2, 519-528(Dec 1972).

Silicon as silicon dioxide in iron and steel-making slags and fluorspars was analyzed by 14 MeV neutron activation high-resolution γ-ray spectrometry. Silicon was detected by measuring the 1.78 MeV γ-ray of ^{28}Al, the product of the $^{28}Si(n,p)$ reaction, using a 30 cm^3 coaxial Ge(Li) detector. A modified TPA method was used for the calculation. ^{28}Al is also produced from phosphorus by the $^{31}P(n,\alpha)$ reaction, and from aluminum by the $^{27}Al(n,\gamma)$ reaction. The contribution from the former reaction could be corrected experimentally when the P_2O_5 content of the sample was known, while the latter reaction could be neglected in this neutron energy region. The experimental correction coefficient for phosphorus agreed well with the theoretical value calculated from the nuclear properties of silicon and phosphorus. Yields of ^{28}Al from SiO_2, P_2O_5, and Al_2O_3 of the same weight percentages were calculated as 1, 0.426 (experimentally 0.44), and 0.0022, respectively. The results of this method agreed well with the results of the usual chemical methods. The limit of detection of SiO_2 in iron and steel-making slags and fluorspars was calculated as 0.07%. The coefficient of variation of repeated experiments was compared with the statistical one. (auth)

2134 NON-DESTRUCTIVE DETERMINATION OF RHODIUM IN PLATINUM BY EPITHERMAL REACTOR NEUTRON ACTIVATION ANALYSIS. Goerner, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Foerster, H. J. Radioanal. Chem.; 12: No. 2, 497-504(Dec 1972).

Neutron activation in connection with Ge(Li) γ-spectrometry proved profitable in determining traces of rhodium (and silver) in pure platinum. As the 556 keV photopeak of ^{104}Rh was chosen for evaluation, its decay behavior had to be considered. Moreover, a special automatic correction of dead-time and decay was applied. The limit of detection in a single run was 5 ppM. (auth)

2135 DETERMINATION OF CERTAIN ELEMENTS IN HUMAN SERUM ALBUMIN BY NEUTRON ACTIVATION ANALYSIS. Anovski, T.; Memedovic, T.; Rastvovac, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). J. Radioanal. Chem.; 12: No. 2, 483-489(Dec 1972).

Instrumental activation analysis was used to determine the contents of certain elements in human serum albumin (HSA). Sample irradiation was performed with a thermal neutron flux of 1.5×10^{13} $n \cdot cm^{-2} \cdot sec^{-1}$ in the RA nuclear reactor of the Boris Kidrič Institute, Vinča. Measurements were performed on a 4096-channel analyser with a high-resolution Ge(Li) detector. The Na, Cu, Br, Au, Hg, Cr, Fe, Ag, Sc, Ba, and Co contents were determined in HSA produced by the Institute for Blood Transfusion, Belgrade. (auth)

2136 DETERMINATION OF Mn, Cu, Zn, K, AND Na IN SMALL TISSUE BIOPSIES BY NEUTRON ACTIVATION ANALYSIS. Plantin, L. O. (King Gustaf V Research Inst., Stockholm). J. Radioanal. Chem.; 12: No. 2, 441-449(Dec 1972).

A method was worked out for the determination of Mn, Cu, Zn, K, and Na in tissue biopsies weighing between 10 and 50 mg. The samples were dried, packed in polyethylene containers, and irradiated at a flux of 1.8×10^{12} $n \cdot cm^{-2} \cdot sec^{-1}$ for 48 hrs. They were dissolved and separated into five fractions by ion exchange chromatography. Manganese was precipitated and counted as MnO_2 and zinc as quinaldate. Copper and potassium were counted in solution. Sodium was taken up in hydrated antimony pentoxide (HAP) and counted in that stage. Accuracy, precision, and specificity were determined by recovery experiments and by analysis of Bowen's biological standard. (auth)

2137 SUBSTOICHIOMETRIC DETERMINATION OF INDIUM AND TIN BY RADIOACTIVATION ANALYSIS. Kudo, K.; Iso, H.; Shigematsu, T. (Nippon Telegraph and Telephone Public Corp., Tokai, Japan). J. Radioanal. Chem.; 12: No. 2, 451-459(Dec 1972).

A method of radioactivation analysis was developed for the determination of indium and tin. It is based on substoichiometric extraction of indium diethyldithiocarbamate into carbon tetrachloride from a slightly ammoniacal solution in the presence of potassium cyanide. With this method, indium can be determined via ^{116m}In (T = 54 min) and tin via ^{113m}In (T = 104 min) which is formed by the reaction $^{112}Sn(n,\gamma)^{113}Sn$. The method was applied to the determination of indium in metallic zinc and of tin in tin-doped gallium arsenide, and 0.4 ppB of indium was analyzed in a zinc sample. (auth)

2138 INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS OF ENVIRONMENTAL POLLUTION. Mamuro, T.; Matsuda, Y.; Mizohata, A.; Takeuchi, T.; Fujita, A. (Radiation Center of Osaka Prefecture, Sakai, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 493-495(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A review is presented on the activation analysis of dust floating in air and contaminants in river water, especially on the result of the activation analysis of water in the River Yodo. In Japan, Be, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, and Pb are the elements of interest for the routine analysis of the dust in air. Neutron activation analysis has one disadvantage that it cannot give experimental data immediately. Also, Pb and Be are difficult to determine by activation. However, activation analysis is advantageous in the application for the continuous, long-term observation of air pollution. For example, 36 elements, such as Na, Al, Se, Br, and Ti, were successfully determined at four points near and in the City of Osaka over the period of a year. Activation analysis was also successfully applied for the determination of 31 elements in polluted river water. It is noteworthy that a peak of ^{239}Np, formed by the reaction $^{238}U(n,\gamma)^{239}U \rightarrow {}^{239}Np$, was clearly found in γ spectra. Studies were made on the water collected at several spots in the River Yodo, one of the most important rivers in Japan. Thirty elements, including Th, Au, and W, were successfully determined. The effects of cleaning treatments were noticed. The elements such as Al, Sc, Fe, Cs, La, Ce, Sm, Eu, Yb, Lu, Ta, W, and Th were well removed by various cleaning treatments. These must have been present as suspended particles. (Japan)

2139 SELENIUM DETERMINATION BY NEUTRON ACTIVATION USING A Po-Be SOURCE. Dutov, A. G.; Kobelev, L. N.;

Kaipov, R. L.; Leushkina, G. V.; Khaidarov, A. A. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 3, 28-29(1972). (In Russian).

A method for the rapid determination of Se in sedimentary rocks by the measurement of the active isomer ^{77m}Se generated by neutron irradiation is described. The neutron source consisted of a Po–Be mixture located at the center of a $60 \times 60 \times 60$ cm^3 cube of paraffin with a 20-cm canal for irradiation of a sample. After a 55-sec irradiation in a flux of about 2×10^4 neutrons/cm^2 · sec, the sample was transferred to the counter of a γ spectrometer. The counting error for ^{77m}Se was estimated to not exceed 1.5%. (KSW)

2140 SIMULTANEOUS NONDESTRUCTIVE DETERMINATION OF FLUORINE AND TITANIUM IN PORCELAIN ENAMELS BY PHOTON ACTIVATION ANALYSIS. Slunecko, J.; Kosta, L.; Kenda, B. (Univ. of Ljubljana, Yugoslavia). Vestn. Slov. Kem. Drus.; 18: No. 1-4, 5-10(1971).

Titanium and fluorine can be determined from one irradiation in the bremsstrahlung beam of a betatron either by the decomposition of the decay curve or by subtracting the contribution of ^{45}Ti to the 0.511-MeV annihilation peak. This contribution is determined from the activity of ^{47}Sc produced by the (γ,p) reaction from ^{48}Ti. From the comparison of results obtained in the application of this technique to the analysis of enamels it can be seen that besides avoiding the decomposition of samples and lengthy distillation it offers the same or better precision, and gives better accuracy provided that geometrical parameters are controlled and standardization is carried out properly. Comparative results illustrating the performance of nuclear and conventional methods for this system are presented. (auth)

2141 METHOD OF DETERMINING THE COMPOSITION OF MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Mitsche, R.; Higatsberger, M. J.; Rumpold, K.; Viehbock, F. (to Osterreichische Studiengesellschaft fuer Atomenergie Ges.). Canadian Patent 907,223. 8 Aug 1972. Priority date 27 May 1968, Austria.

The process claimed is activation analysis by using short pulses of neutrons with energy <0.1 MeV adjusted to correspond to the resonance level of the element being analyzed, so as to generate prompt pulses of gamma rays, whose spectrum is then registered by a gamma ray spectrometer. The invention particularly refers to analytical control of the composition (e.g., oxygen and phosphorus content) of steel in a basic oxygen converter. In a preferred embodiment of the invention, a slow neutron source, consisting of an ion accelerator, target, and moderator, is contained in an oxygen lance. The converter has a window, through which the emitted gamma rays pass, and they are then measured by a Li/Ge spectrometer. The results may be fed into a computer and used to control the process of making steel. (Canada)

2142 DETERMINATION OF THE URANIUM CONTENT OF ORES BY NEUTRON ACTIVATION. Hofmann, H. P. (AEG-Telefunken, Grosswelzheim, Ger.). Z. Anal. Chem.; 263: No. 2, 108-110(1973). (In German).

The samples are activated within 5 hr by a neutron flux of 5.4×10^9 sec$^{-1} \times$ cm^{-2}. After 48 hr, the activity is measured by γ spectroscopy employing a Ge(Li) detector. The 228 and 227 keV γ lines of Np-239 are used for the determination. The results show good agreement with those obtained by other methods. (GE)

2143 DETERMINATION OF MERCURY CONTENTS IN DIVERSE SAMPLES OF FISH AND OTHER BIOLOGICAL MATERIALS BY NEUTRON ACTIVATION ANALYSIS. Ruf. H.; Rohde, H. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Anal. Chem.; 263: No. 2, 116-120(1973). (In German).

Mercury contents in diverse samples of fish and other biological materials were determined by a neutron-activation analysis measuring the activity of Hg-197. A method described in literature was used for the indispensable separation of the mercury activity utilizing the volatility of $HgCl_2$ and the low electric potential of deposition of mercury metal. Seriously high contents of mercury were found in some samples of Japanese canned tuna and whitefish of the Rhine river. (GE)

2144 GAMMA-ACTIVATION METHOD FOR DETERMINING OXYGEN IN SODIUM. Chapyzhnikov, B. A.; Evzhanov, Kh.; Malikova, E. D.; Kunin, L. L.; Samosyuk, V. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 1, 57-60(Jan 1973). (In Russian).

A gamma activation method was developed for determining oxygen in sodium with a sensitivity of 2×10^{-5} weight per cent. The method of radiochemical separation of the ^{15}O isotope is based on the exchange between oxygen contained in the metal as oxides and hydroxides and oxygen of the water in which metallic sodium is dissolved after the irradiation and etching of the surface. The distillation of the water for 2 min allows separation of the oxygen from the matrix radioisotopes. The effect of dissolving and two competitive processes, distilling and the decay of the short-lived isotope on the determination sensitivity has been shown. The method makes possible the determination of 10^{-2} to 10^{-3}% of oxygen in sodium with good precision (the variation coefficient is about 10%). (auth)

2145 APPLICATION OF THE NEUTRON ACTIVATION ANALYSIS IN DETERMINING THE THICKNESS OF ANODIC OXIDE FILMS ON SILICON. Golanski, A. Elektronika; 13: No. 11, 448-453(Nov 1972). (In Polish).

Anodic oxidation of silicon involves several problems such as the appropriate choice of the electrolyte, the proper insertion of the voltage electrodes, and the monitoring of the oxide thickness. Activation analysis is one of the methods used now for measuring this thickness. It is based on a nuclear reaction in a thermal neutron flux and a subsequent isotope or activity count. The accuracy of the method depends on the feasibility of rejecting interference activity, on adequate measurement statistics, on the self-shielding effectiveness of the specimen, and on the radiation partly re-absorbed in the specimen during measurements. It requires a careful preparation and calibration of standard reference specimens. A typical procedure is to oxidize a silicon wafer of definite dimensions in acetylomethyloamine as electrolyte, then to expose it to a neutron flux, and to remove the oxide layer in a hydrofluoric solution with barium hydroxide. (JPRS)

2146 APPLICATION OF ACTIVATION ANALYSIS TO THE STUDY OF AIR POLLUTION. Asakuno, K. (Tokyo Metropolitan Research Inst. for Environmental Protection). Bunseki Kiki; 10: No. 9, 563-570(Sep 1972). (In Japanese).

Outline and merits of applying activation analysis to the identification and quantitative analysis of atmospheric pollutants are described. The typical pollutants together with their γ-ray spectra, half life, and nuclear reaction cross section are summarized in a table. Some examples of the activation analysis of atmospheric pollutants are reviewed. The density distribution of Mn and Br was measured by utilizing Tokyo Tower to analyze diffusing mechanism of the pollutants. Gamma-ray spectra of small particles (above 1.0 μ) contained in the atmosphere of Tokyo are shown. Comparison of the sensitivity of major elements to the various methods of analysis is also summarized in a table. It is shown that by utilizing activation analysis, La, V, W, Yb, Mn, Br, Cl, Ln, Pd, Re, Na and Sm can be analyzed with high sensitivity. As the merits of the activation analysis, the following points are emphasized. (1) simultaneous analysis of many elements (20 to 30) can be performed without chemical pretreatment; (2) feasibility of automatic analysis by the use of computers; and (3) high sensitivity for particular elements. As the demerits, restriction of reactor usage and lack of information about chemical structure are pointed out. (Japan)

2147 OPREDELENIE KISLORODA, UGLERODA, AZOTA I VODORODA V SHCHELOCHNYKH I SHCHELOCHNOZEMEL'NYKH METALLAKH. (Determination of Oxygen, Carbon, Nitrogen, and Hydrogen in Alkali and Alkaline Earth Metals). Kunin, L. L.; Malikova, E. D; Chapyzhnikov, B. A. Moscow; Atomizdat (1972). 177p.

The physicochemical bases of methods of analyzing for O, C, N, and H in alkali or alkaline earth metals are discussed. Of special interest here are brief summaries of the conditions of formation of the oxides, nitrides, carbides, and hydrides of Be, and radiochemical methods of determining certain metals: the nuclear reaction ^{16}O(n,p)^{16}N, methods using the charged particles p, d, t, ^{3}He, ^{4}He, and gamma activation techniques. Considerable attention is devoted to special laboratory equipment used in the analyses. 297 references. (KSW)

2148 ACTIVATION ANALYSIS WITH ^{252}Cf SPONTANEOUS FISSION NEUTRONS. Ishii, D. (Nagoya Univ., Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 377-379(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Special features of a ^{252}Cf neutron source and its application to activation analysis are reviewed. First, the special features of ^{252}Cf as the neutron source are a high yield of neutrons, small size, small heat generation, and stability of neutron flux. The future prospect of ^{252}Cf production is 100 g/year in 1980. Some examples of the activation analysis with ^{252}Cf are given. Especially, the quantitative determinations of fluorine in various fluorine compounds and of hafnium to the extent of about 100 ppM in zircaloy are explained in some detail. (Japan)

2149 PRACTICAL EXPERIENCE WITH THE NEUTRON ACTIVATION ANALYSIS OF WATERS. Schmitz, J.; Schneider, J.; Vogg, H. Gas-Wasserfach, Wasser-Abwasser; 113: No. 7, 318-324(1972). (In German). (KFK–1533).

From eight locations within the seepage area of the Danube river, water samples were subjected to neutron activation analysis. Fast neutrons of 14 MeV detected predominantly macro-components, such as N, Na, Mg, Al, Si, Cl, K, Ca, Sr, and Ba. Short-term exposure to reactor neutrons yielded Na, Mg, Cl, K, Br, Sr, and I. After long-term exposure to reactor neutrons, the gamma spectrum revealed Na, Ca, Sc, Cr, Fe, Co, Zn, Se, Br, Rb, Sr, Sb, Cs, Ba, La, Ce, Yb, Hf, Au, Hg, Th, and U. The seepage was also studied by lanthanum addition to the water with subsequent neutron activation analysis. (HBG)

2150 ACTIVATION ANALYSIS OF HAIR FOR FORENSIC APPLICATIONS. Gangadharan, S.; Lakshmi, V. V.; Das Sankar, M. (Bhabha Atomic Research Centre, Bombay). J. Indian Acad. Forensic Sci.; 11: No. 1, 18-21(1972).

The application of nuclear activation technique to the determination of trace elements in hair and the parameters affecting the results are given. The program of work in forensic activation analysis of hair is outlined and some preliminary results are discussed. (Indian Sci. Abstr.)

2151 DETERMINATION OF TRACE FLUORINE IN BIOLOGICAL MATERIALS BY PHOTONUCLEAR ACTIVATION ANALYSIS. Ohno, S.; Suzuki, M.; Kadota, M.; Yatazawa, M. (National Inst. of Radiological Sciences, Chiba, Japan). Mikrochim. Acta; No. 1, 61-68(1973).

By using the photonuclear activation technique, fluorine was determined in biological materials. After alkali fusion, fluorine is adsorbed on an anion exchange resin. The irradiated resin sample is soaked and stirred in 5N hydrochloric acid solution. After filtering, fluorine-18 resulting from the (γ,n) reaction was extracted with 0.2% dimethyldichlorosilane in xylene. The fluorine-18 0.51-MeV annihilation peak in an aliquot of the organic phase was measured by gamma spectrometry. The precision of this method, calculated from replicate analyses of a standard specimen, is ±11%, and the sensitivity is estimated as 0.01 μg for this element. (auth)

2152 ERRORS OF NEUTRON ACTIVATION ANALYSIS CONNECTED WITH MONITORING THE NEUTRON FLUX IN A NEUTRON GENERATOR. Lisovskii, I. P.; Smakhtin, L. A. (Physical-Chemical Inst., Moscow). Zh. Anal. Khim.; 28: No. 2, 231-234(Feb 1973). (In Russian).

Instability ("jumps") of the neutron flux during the irradiation affects essentially the analysis accuracy if a neutron flux monitor with a half-life different from that of the analytical isotope is used instead of standards and the true exposure time differs from the adjusted one. (auth)

2153 ACTIVATION DETERMINATION OF IMPURITIES IN NIOBIUM AND ITS COMPOUNDS. Shmanenkova, G. I.; Firsov, V. I.; Shchelkova, V. P.; Shchulepnikov, M. N. (State Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 28: No. 2, 323-327(Feb 1973). (In Russian).

Methods were developed for instrumental and radiochemical modifications of the neutron activation analysis of niobium and its compounds. The expedience of using one of the variants for the determination of impurities in niobium and its compounds is discussed. (auth)

2154 NEUTRON-ACTIVATION DETERMINATION OF TANTALUM IN MINERALS, ORES, AND ROCKS USING A SEMICONDUCTOR γ-SPECTROMETER. Sukhov, G. V.; Firsov, V. I.; Lontsikh, S. V. (State Scientific-Research and Design Inst. of Rare Metal Industry, Moscow). Zh. Anal. Khim.; 28: No. 2, 312-315(Feb 1973). (In Russian).

Neutron activation method was developed for determining tantalum using a semiconductor γ-spectrometer with a Ge(Li)-detector (21 cm^3 in volume), its sensitivity is 1×10^{-5}%. The effect of accompanying elements was elucidated. (auth)

2155 STUDY OF THE DETERMINATION OF OXYGEN IN MOLYBDENUM BY VACUUM EXTRACTION IN METALLIC MELTS SATURATED WITH CARBON. Burzev, V. T.; Saksonova, L. N.; Kashin, W. I. (Inst. of Metallurgy, Moscow). Neue Huette; 17: No. 12, 732-738(Dec 1972). (In German).

Degasification processes were studied during the determination of oxygen in various molybdenum samples and were compared with theoretical considerations of the degasification kinetics. Extraction of oxygen from molybdenum (approximately 70 ppM oxygen mass) after vacuum melting in tanks of Pt–C, Ni–Fe–C, and Fe–C was 100, 62, and 22%, respectively. Extraction time for molybdenum with nonmetallic inclusion of La_2O_3, B_2O_3, ZrO_2, and SiO_2 increased between three- and tenfold to 27 or 28 minutes. Correctness of the oxygen content could be supported by the good agreement with results of vacuum heat extraction using the isotope dilution analysis on the system Ni–Mo–C–^{18}O–^{12}C–^{16}O. (tr-auth)

Chemical and Spectral Procedures

Refer also to abstract 2596.

2156 (ARH-2624) DETERMINATION OF SULFUR BY SPECIFIC ION ELECTRODE AFTER SEPARATION FROM PLUTONIUM AND URANIUM OXIDES BY DISTILLATION. Winters, W. I.; Metcalf, S. G. (Atlantic Richfield Hanford Co., Richland, Wash.). Mar 1973. Contract AT(45-1)-2130. 51p. (CONF-730403-3). Dep. NTIS $3.00.

From 165th meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

A method for the determination of sulfur in uranium and plutonium oxides and nitrates was developed using a sulfide specific ion electrode. Following the destruction of nitrates with formic acid, samples were dissolved in concentrated hydrochloric acid. Plutonium(IV) was reduced to plutonium(III) with hydroxylamine hydrochloride. Sulfur in the samples was then reduced to hydrogen sulfide with a mixture of hydriodic and hypophosphorus acids. The hydrogen sulfide was distilled for 30 to 45 min depending on sample size and trapped in a sulfide anti-oxidant buffer. Sulfide was then measured directly in the buffer using a sulfide specific ion electrode. The method is capable of measuring 10 μg of sulfide per g of sample with a precision of ±15%. Lower detection limits are possible with poorer precision and are limited by the amount of sulfur in the reagent blank. A method for purifying the hydriodic and hypophosphorus acids mixture is described and the sulfur contamination in other reagents examined. The method has been successfully used to analyze nuclear fuel materials for the Fast Flux Test Reactor Facility. (auth)

2157 (EUR-4927) AUTOMATIC DEVICE FOR SEPARATION OF URANIUM AND PLUTONIUM FROM SPENT NUCLEAR FUEL BY ION EXCHANGERS FOR MASS SPECTROMETRY. Bol, D.; Brandalise, B.; Bier, A.; De Rossi, M.; Koch, L. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). Mar 1973. 15p. (In German). Dep. NTIS (U. S. Sales Only) $3.00. EUR.BF.40.-.

An automatic device was developed which separates uranium and plutonium from nuclear fuel for their isotope analysis. Up to six samples can be separated by ion exchangers simultaneously. The addition of wash and eluent as well as the collection of up to five fractions per column is automated. The volumes of wash, eluent and fractions can be chosen individually for each column. The filling of the column is controlled by a light barrier. Pumps, valves and fraction collectors are operated by a control unit based on the digital technique. (auth)

2158 (FRNC-TH-335) DETERMINATION OF VERY SMALL QUANTITIES OF RARE EARTHS IN TERRESTRIAL ROCK SAMPLES (B.C.R.1) AND LUNAR ROCK SAMPLES (APOLLO 14) USING MASS SPECTROMETRY. Puil, G. (Paris Univ., Orsay (France)). 1972. 46p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

Thesis.

A very sensitive method for the accurate determination of very small quantities of rare earth elements contained in rock samples was developed. Improvements were made to the isotopic dilution method using thermionic source mass spectrometry. High sensitivity was obtained by reducing the pollution due to natural elements with the utilization of a more suitable chemical separation technique. The accuracy of the method was increased by obtaining pure mass spectra and diminishing sources of error such as those due to mass discrimination and the lack of purity of the labeling compounds. In order to fulfill this requirement, the labeling substances were calibrated. The rare earths contained in basaltic rock (B.C.R.I.) and the lunar sample 14305 brought back from the Apollo 14 mission were determined. The results obtained confirm a very significant absence of Eu in relation to other rare earths. This phenomenon is due to the reduction of Eu^{3+} to the Eu^{2+} state, which enables this element to preferentially concentrate in the plagioclase during the fractional crystallization and/or partial melting of the lunar surface. (France)

2159 (HEDL-SA-434) SHIELDED ELECTRON MICROPROBE ANALYSIS OF IRRADIATED MIXED OXIDE FUELS. Jenson, E. D. (Westinghouse Hanford Co., Richland, Wash. (USA)). [nd]. 40p. (CONF-721025-14). Dep. NTIS $4.00.

From 16th conference on analytical chemistry in nuclear technology; Gatlinburg, Tennessee, USA (24 Oct 1972).

The use of shielded electron microprobe analysis for determining the uranium and plutonium concentrations across the pin in several locations on either transverse or longitudinal sections; determining fission product concentration profiles, e.g., molybdeum,

cesium, and xenon, in several locations; and examining in detail the cladding for any form of attack or degradation on either the OD or the ID is described. (DHM)

2160 (SGAE-PH-138/73) ASPECTS OF QUALITATIVE AND QUANTITATIVE ANALYSIS IN SECONDARY ION MASS SPECTROMETRY. Ruedenauer, F. G.; Steiger, W.; Portenschlag, R. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Jan 1973. 45p. (In German). (SGAE-2082; CONF-721087-1). Dep. NTIS (U. S. Sales Only) $4.50.

From 6th conference on metallurgical analysis; Vienna, Austria (23 Oct 1972).

It is shown that during heavy ion bombardment of solids secondary cluster ions with up to 18 atoms/cluster can be emitted. Selecting out only secondary ions with high initial energy, cluster ions can be discriminated against monatomic ions. The spectrum of atomic ions usually is used for elemental analysis of a target, the cluster ion spectrum allows information to be obtained concerning the chemical state of the elements present. Two theoretical models of secondary ion emission are treated: the adiabatic surface ionization model and the LTE-Plasma model. Examples for gradient analyses on solid surfaces are given and the concept of fingerprint spectra is discussed which allows phase analysis of oxidized metal surfaces. (auth)

2161 DETERMINATION OF TRIVALENT EUROPIUM CONCENTRATION IN YTTRIUM OXYSULFIDE PHOSPHOR. Ozawa, L.; Forest, H. (Zenith Radio Corp., Chicago). Anal. Chem.; 45: No. 6, 978-979(May 1973).

The active trivalent europium concentration in a given Y_2O_2S:Eu phosphor can be easily and accurately determined from the luminescence intensity ratio of selected $^5D_1$(green-orange spectral region) and $^5D_0$(yellow-red spectral region) luminescent lines. The variation in the absolute luminescent intensity due to synthesis procedure is compensated for by measuring line ratios. The accuracy of this procedure is within ±0.05 mole % error. (JGB)

2162 SECONDARY ION EMISSION FOR SURFACE AND IN-DEPTH ANALYSIS OF TANTALUM THIN FILMS. Morabito, J. M. (Bell Telephone Labs., Inc., Allentown, Pa.); Lewis, R. K. Anal. Chem.; 45: No. 6, 869-880(May 1973).

The Cameca Ion Microanalyzer was used to analyze the surface and bulk of a number of sputtered tantalum thin films for trace impurities. This technique of chemical analysis has unique analytical capabilities which are based on the emission and subsequent mass analysis of characteristic secondary ions ejected by high energy (several keV) ion bombardment. The results obtained on sputtered tantalum films, reactively sputtered (argon–oxygen, argon–nitrogen mixtures) tantalum films, and oxidized tantalum films are presented to demonstrate these unique analytical capabilities. Quantitative analysis by this method is shown to depend on the accurate and reproducible measurement of characteristic parameters such as the secondary ion current of the impurity (i_{si}) and the secondary ionization yield of the impurity relative to the matrix (K_{rel}). The magnitude of K_{rel} is best determined by the use of standards. (auth)

2163 CONTROLLED-POTENTIAL COULOMETRIC DETERMINATION OF PLUTONIUM-238 IN PLUTONIUM-238 DIOXIDE FUELS. MacDougall, C. S.; Waterburg, G. R. (Los Alamos Scientific Lab., N. M.). Anal. Chem.; 45: No. 6, 976-978(May 1973).

An attempt was made to modify existing coulometric methods for the determination of ^{238}Pu in PuO_2 fuels in order to develop an accurate and precise method for analysis of small samples with minimum radiolytic interference. Interfering substances were scavenged as they formed by 1N HCl. An average Pu recovery of 99.96% was obtained with a standard deviation of ±0.04%. Results were compared with those obtained using an H_2SO_4 medium. Am, Mo, Th, Co, U, Ni, Cr, Np, Ga, Cu, Rh, Al, Fe, and Ir did not interfere. V, Mn, Nb, Hf, and Ru did interfere. (JGB)

2164 REACTIONS OF Ce^{3+} AND Ce^{4+} WITH CUPFERRON AND THE DETERMINATION OF CERIUM IN SOME MATERIALS. Mazharovskaya, G. S.; Vasilenko, V. D.; Novak, V. P.; Mal'tsev, V. F. (Dnepropetrovsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 2, 190-194(1973). (In Russian).

The reactions of Ce(III) and Ce(IV) with cupferron were investigated in 0.1 N solutions of several common acids and salts using the methods of potentiometry, spectrophotometry, and amperometric titration. Ce(IV) was reduced to Ce(III) in H_2SO_4; when the pH was adjusted to 3.0 reduction still occurred, forming a precipitate of $Ce(Cup)_3$. Amperometric determination of Ce was demonstrated in cast iron, alloy steels, and magnesium alloys. (KSW)

2165 ATOMIC EMISSION SPECTROMETRY WITH AN INDUCTION-COUPLED HIGH-FREQUENCY PLASMA SOURCE. The Determination of Iodine, Mercury, Arsenic, and Selenium. Kirkbright, G. F.; Ward, A. F.; West, T. S. (Imperial Coll. of Science and Tech., London). Anal. Chim. Acta; 64: No. 3, 353-362(May 1973).

The application of an inductively coupled high-frequency plasma source to the determination of iodine, mercury, arsenic and selenium in aqueous solutions by atomic emission spectrometry at wavelengths less than 200 nm is described. Optimal conditions were established, and the spectral interference effects at different atomic lines for each element were investigated. With the type of instrumentation employed, the determination of iodine at 183.04 nm, mercury at 184.96 nm, arsenic at 189.0 nm, and selenium at 196.09 nm is recommended to minimize spectral interferences. No chemical or physical interferences resulting from the influence of foreign ions on the solute vaporization process were noted. (auth)

2166 CADMIUM, CHROMIUM, LEAD, AND MERCURY: PLENARY ACCOUNT FOR WATER POLLUTION. I. Occurrence, Toxicity, and Detection. Cheremisinoff, P. N.; Habib, Y. H. Water Sewage Works; 119: No. 7, 73-74; 78; 80-86(1972).

A review is given of methods for the determination of these metals (e.g., molecular and atomic absorption, spectrophotometry, polarography, and activation analysis), limits of detection, and concentration techniques. The nature, source, use, and toxicity of each metal is discussed. (Anal. Abstr.)

2167 IS IT POSSIBLE TO IDENTIFY INDIVIDUALS BY NEUTRON ACTIVATION ANALYSIS OF HAIR. Failure of a Mission. Cornelis, R. (State Univ., Ghent). Med., Sci. Law; 12: No. 3, 188-194(Jul 1972).

Neutron activation analysis (NAA) studies on hair were assessed as to their value for the identification of individuals. The acid-digested samples from various individuals were irradiated in a swimming-pool type reactor. A well-type Ge/Li detector was used for the γ detection of Zn, Cu, Au, Hg, As, Sb, and Mn. The precision of the analysis, the dispersion of the elements in the hair of an individual on different parts of his head and on successive dates, as well as the degree of distribution of trace elements in hair over a population were taken into consideration. Results indicate that the assessment of trace elements by NAA (or any other method) for identification purposes is unreliable. (auth)

2168 USE AND EVALUATION OF GAS CHROMATOGRAPHY FOR DETERMINATION OF DEUTERIUM IN BODY FLUIDS. Nielsen, W. C. Jr.; Krzywicki, H. J.; Johnson, H. L.; Consolazio, C. F. (Fitzsimons General Hospital, Denver). J. Appl. Physiol.; 31: No. 6, 957-961(1971).

The method of Arnett and Duggleby (Analyt. Abstr., 1964, 11, 3521) was used (with minor modifications) to detect tracer ^2H_2O in urine, serum, and saliva. Recoveries of added ^2H_2O from urine and serum averaged 99.2 ± 1.4% and 100.6 ± 1.6%, respectively; these are similar to previously reported values. Estimates of total-body H_2O for two human subjects, by ^2H_2O dilution technique, were reproducible to within 0.5 litre. After initial equilibration the concentration of ingested ^2H_2O in saliva and serum was very similar. (Analytical Abstracts)

2169 COPPER IN UO_2–SiO_2 VITROCERAMICS. Beleuta, I. L. (Inst. of Atomic Physics, Bucharest). Radiochem. Radioanal. Lett.; 13: No. 5-6, 369-373(30 Apr 1973).

A preliminary study on the distribution of copper in rods of UO_2–SiO_2 type vitroceramic fuel is reported. The admission of copper into these rods takes place at the instant of absorption of the vitroceramics melt into a copper fusible mould. The copper content at the surface, as determined by using a specially adapted polarographic method, was of 0.005 to 0.050%, and is decreasing as depth increases. The maximum penetration depth is up to 100 to 260 μm. (auth)

2170 SPECTROPHOTOMETRIC STUDIES OF URANYL CHELATE OF 7-IODO-8-HYDROXYQUINOLINE-5-SULPHONIC ACID. Hseu, T. M.; Kuo, K. N. (National Taiwan Univ., Taipei). J. Chin. Chem. Soc. (Taiwan); 19: No. 4, 161-171(Dec 1972).

Uranyl chelate of 7-iodo-8-hydroxyquinoline-5-sulfonic acid (ferron) was studied spectrophotometrically in aqueous solution at 25°C and at an ionic strength of 0.1 M. The formation of this chelate was pH dependent, and the optimum pH range was between 5.4 to 5.9. Its mole ratio of ligand to uranyl ion was found to be 2 to 1 stoichiometry and the stability constant, log K, was determined to be 13.32 ± 0.08. By using the wave-length of 365 mμ, the determination of trace amounts of uranyl ion with a sensitivity of 0.54 γ/cm^2 was possible. (auth)

2171 TRACE ELEMENT DETERMINATIONS ON LAKE MICHIGAN TRIBUTARY WATER SAMPLES USING SPARK SOURCE

MASS SPECTROMETRY. Wahlgren, M. A. (Argonne National Lab., Ill.); Edgington, D. N.; Rawlings, F. F.; Rawls, J. L. pp 298-305 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

The technique necessary to make conducting electrodes for spark source mass spectrometric trace element analysis of lake and tributary water samples have been developed. Improvements in preparation and operating techniques during the method development improved the internal precision (based on relative photoplate densities from several exposure times) from ~40% to ~20%. Water samples from Lake Michigan tributaries have been analyzed for 37 elements by the method. The precision of the method is adequate for many environmental water chemistry problems. Further study will be required to establish the accuracy which can be attained and to identify and eliminate matrix interferences. (auth)

2172 MICRODETERMINATION OF IODINE IN CARRIER-FREE ^{131}I SOLUTIONS. Kurcbart, H. (Comision Nacional de Energia Atomica, Buenos Aires); Quiroga, S.; Caro, R. A.; Radicella, R. J. Radioanal. Chem.; 12: No. 2, 547-552(Dec 1972).

A photocolorimetric microtechnique is described, by which it is possible to determine the real amount of iodine in carrier-free solutions of ^{131}INa. The method is conceptually based on the well-known effect of iodine, by which the rate of reduction of ceric sulfate by arsenious acid in sulfuric acid solutions is proportional to the iodide concentration. The titration and the preparation of its corresponding calibration graph require approximately 90 min; thus, it seems possible to use this technique as a routine analysis. Under the stated conditions of temperature and reaction time, it is possible to determine samples of iodine with concentrations ranging between 20 and 160 ng/ml. The standard error between different determinations is less than ±5%. The application of the method in production control and utilization of carrier-free ^{131}I solutions, free from reducing agent, are discussed. (auth)

2173 INDIRECT POLAROGRAPHIC DETERMINATION OF THORIUM AND SCANDIUM IN PRESENCE OF LANTHANIDES. Sevryukov, N. N.; Dorofeeva, G. I. (Univ. of People Friendship, Moscow). Zh. Anal. Khim.; 28: No. 1, 77-80(Jan 1973). (In Russian).

A method was suggested and tested for the indirect polarographic determination of small amounts of thorium (0.5 to 6 mg) or scandium (1 to 10 mg) in the presence of 100-fold amounts of lanthanides; the elements are determined by indium replaced by them from $InEDTA^-$. A possibility was shown for determining a sum of thorium, scandium, and lanthanides by manganese replaced by them from $MnEDTA^{2-}$. The sum of lanthanides can be determined by the difference. (auth)

2174 SPECTRAL DETERMINATION OF NIOBIUM, TANTALUM, AND ZIRCONIUM IN ORES OF DIFFERENT COMPOSITION. Izmailova, D. N.; Zakhariya, N. F. (Inst. of General and Inorganic Chemistry, Odessa). Zh. Anal. Khim.; 28: No. 1, 95-100(Jan 1973). (In Russian).

It is necessary to maintain similar conditions for the evaporation of elements to be determined from the electrode arc and simultaneously those for the excitation to get rid of the effect of the sample composition on the analysis results in the determination of Nb, Ta, and Zr in ores of different kinds. The excitation conditions are characterized by the presence of easily ionized Na and Al (main components of aluminosilicate basic rocks) in the arc plasma. A procedure for determining Nb, Ta, and Zr in ores of different kinds containing 0.002% Nb, 0.005 Ta, 0.001% Zr and higher is suggested. (auth)

2175 OXYGEN ISOTOPE ANALYSIS AS A MEANS OF DETERMINING SEASON OF OCCUPATION OF PREHISTORIC MIDDEN SITES. Shackleton, N. J. (Cambridge Univ., Eng.). Archaeometry; 15: No. 1, 133-141(Feb 1973).

By making oxygen isotope palaeotemperature determination of successive growth increments in molluscan food-refuse shells it is possible to determine the sea temperature, and hence the season, at time of death of the shells. Although this is a method that involves the use of sophisticated and expensive equipment, it may under favorable circumstances give extremely reliable results. Shells of the limpet species Patella tabularis in the midden deposits at Nelson Bay Cave, Robberg, Cape Province, South Africa, prove to represent almost ideal material, and are used to demonstrate, contrary to what guesswork might lead one to suppose, that the site was occupied during the winter months. (auth)

2176 ASSOCIATION FORMATION OF THE ALKALITRIPHENYLPHOSPHONIUM CATION WITH MOLYBDENUM(VI) ANIONS. Grebenova, B.; Vrchlabsky, M. (Prukyne Univ., Brno). Collect. Czech. Chem. Commun.; 38: No. 2, 394-400(Feb 1973). (In German).

Studies of the acid-base equilibria in aqueous Mo(VI) solutions demonstrated that, in the presence of phosphonium salt cations at a pH below 3, stabilization occurred which yielded the oligomeric heptamolybdates with the formation of white precipitates of the probable composition ($5\ L^+$, $HMo_7O_{24}^{5-}$). Analysis of the precipitates and evaluation of the precipitation titration confirmed the composition. The formation of the associate between Mo(VI) and the onium salt cation, however, could not be used for the gravimetric determination of Mo(VI), or quarternary salts, because 80% of the molybdenum precipitated from the 10^{-2} M molybdate solutions. (tr-auth)

2177 ORGANIC REAGENTS IN ANALYTICAL CHEMISTRY OF SELENIUM AND TELLURIUM. Communication 4. Study of Reaction of Diphenylthiourea with Bromide Complex of Tellurium. Mel'chekova, Z. E.; Murashova, V. I. (Ural Polytechnic Inst., Sverdlovsk, USSR). Zh. Anal. Khim.; 28: No. 1, 105-111(Jan 1973). (In Russian).

The interaction of a bromide complex of Te(IV) with diphenylthiourea (DFTU) was studied. Optimum conditions for the complex formation are 5.4 to 7.2 M H_2SO_4, 0.2 M NaBr, and 20-fold excess of the reagent. The molar extinction coefficients for the Te(IV) · 3DFTU compound are 1.45×10^4 (at 380 to 390 nm) and 5.85×10^3 (at 480 nm). The molar ratio of Te : R : Br is 1 : 2 : 6. The dissociation constants for the compound, calculated by the Babko method and the equilibrium shift, are $(9.3 \pm 2.0) \times 10^{-6}$ and 2.3×10^{-6}, respectively. Cu(II), Fe(III), Cr(VI), Mn(VII), Sn(IV), V(V), Au(III), As(III), Pd(II), and Bi(III) interfere. Less and comparable with tellurium amounts of selenium do not interfere markedly. An extraction-photometric method was developed for the determination of tellurium using DFTU. The method was tested on technological samples (a sulfide ore and a steel). The relative error for the determination of tellurium in the ore is 1.99%. (auth)

2178 TITRIMETRIC DETERMINATION OF SELENIUM(IV) BY LEAD NITRATE SOLUTION USING 4-(2-PYRIDYLAZO)-RESORCINOL. Eshvar, M. S.; Nagarkar, S. G. (Indian Inst. of Tech., Bombay). Zh. Anal. Khim.; 28: No. 1, 179-180(Jan 1973). (In Russian).

Amounts of selenite (1.5 to 7.1 mg) were determined by precipitation titration with Pb^{2+} using rose-red Pb^{2+}–PAR chelate for end point detection. The titration is done in the pH range 7.5 to 8.5 at a temperature of 60 to 70°C and in the presence of about 0.2 g of hexamine. Results are comparable favorably with those obtained by other methods. Attempts for determination of tellurite by a similar procedure have failed, probably due to solubility factors. (auth)

2179 STUDY OF THE THORIUM–PURPURIN COMPLEX BY BUTANOL EXTRACTION. Dragulescu, C.; Simonescu, T.; Totan Curtui, M. (Center of Chemistry, Timisoara, Romania). Rev. Roum. Chim.; 18: 43-48(Jan 1973).

Optimum conditions of thorium extraction with a butanol solution of purpurin in the presence of trichloroacetic acid were established. The composition and the stability of the complex were determined in butanol medium, the instability constant being $K = 1.02 \times 10^{-7}$. The extractive-spectrophotometric method described was used for the determination of thorium in certain alloys and monazitic earths. (auth)

2180 ISOTOPE DILUTION, SURFACE IONIZATION MASS SPECTROSCOPIC ANALYSIS. An Example of Determination of Lead in the Air in Urban Districts. Murozumi, M. (Muroran Inst. of Tech., Hokkaido, Japan). Bunseki Kiki; 10: No. 12, 791-797(Dec 1972). (In Japanese).

Introduction is made on the pollution of natural environment by lead, the importance of the measurement of lead content in air and in water, the principle of and apparatuses for the measurement of lead by isotopic dilution method, the method of sampling, the synthesis of PbS to be used for mass spectrometry, the sensitivity, accuracy, and rapidity of the mass spectrometry, and methods to remove lead from laboratory apparatuses and reagents. According to this method, the determination of lead is possible down to 10^{-3} μg level with the accuracy of 10^{-11} μg. Results of the measurement of lead in the air collected at various places near Muroran Harbor, Hokkaido, indicated that the lead content in air was about 1 μg/m³ between Aug. 15 and 19th, 1968. For the determination of lead by isotopic dilution, surface ionization method, lead spike solution containing 0.072 μg ^{206}Pb, 0.020 μg ^{207}Pb, and 35.32 μg ^{208}Pb per 0.100 ml is added, and left ^{207}Pb standing until isotopic equilibrium is reached. The lead content x is determined by the ratio of ^{208}Pb and ^{206}Pb. The ratio is

determined by the mass spectroscopy. For the mass spectroscopy, lead is transformed to PbS, which is evaporated on a tantalum filament by heating. Sensitization of the spectrum is performed by producing the mass spectrum of Pb^+. A mass spectrometer Type RMU 6 made by Hitachi, Ltd. was used for the study. (Japan)

2181 EXTRACTION AND PHOTOSPECTROMETRIC DETERMINATION OF MOLYBDENUM IN A THREE-COMPONENT COMPLEX WITH PYROCATECHOL AND ALKYLTRIPHENYLPHOSPHONIUM CATION. Grebenova, B.; Vrchlabsky, M. (Prukyne-Univ., Brno). Collect. Czech. Chem. Commun.; 38: No. 2, 379-393(Feb 1973). (In German).

The three-component complex of Mo(VI) with pyrocatechol and alkyltriphenylphosphonium cation is extracted from an aqueous solution with 7 N H_2SO_4 in a chlorinated hydrocarbon up to the pH value of 2. Its green color with absorption maxima at 620 and 410 nm, which permits the selective, extraction-photometric determination of molybdenum in the presence of other elements, is the result of electron shifts through the association of the onium cation with the anion complex of Mo(VI)-pyrocatecholate. The assumed composition of the association (L^+, $HMoO_2R_2^-$) is derived from the photometric analysis of the extract. (tr-auth)

2182 ORGANIC REAGENTS IN INSTRUMENTAL (PHYSICAL CHEMICAL) ANALYTICAL METHODS. Nemodruk, A. A. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 1, 138-151(Jan 1973). (In Russian).

Applications of organic reagents in different instrumental methods of analysis and their necessary properties are discussed briefly. (254 references) (auth)

2183 AMPEROMETRIC TITRATION OF LANTHANUM ION AND ITS MIXTURES WITH OTHER ELEMENTS BY COMPLEXONE III USING ROTATING TANTALUM ELECTRODE. Markhabaev, I. A.; Zhdanov, A. K. (Tashkent State Univ.). Zh. Anal. Khim.; 28: No. 1, 168-170(Jan 1973). (In Russian).

Conditions were studied for the direct amperometric titration of lanthanum with a Complexone III solution. The reproducibility, accuracy, and titrated concentration limit were estimated. The separate quantitative determination of La, Mg, and Fe as well as La, Th, and Bi in mixtures can be carried out by successive amperometric titrating with Complexone III by the anodic current. (auth)

2184 AMMONIA METHOD FOR DETERMINING HALOGENS IN ORGANIC SUBSTANCES USING ELECTRIC GLOW DISCHARGE. Volodina, M. A.; Moroz, N. S.; Bogorodskii, M. M. (Moscow State Univ.). Zh. Anal. Khim.; 28: No. 1, 180-183(Jan 1973).

Determination of halogens (chlorine, bromine, iodine, fluorine) in organo-halogen substances is based on the sample decomposition in the electric glow discharge (50 to 100 W) in an ammonia atmosphere (5 to 10 mm of mercury column). The duration of the sample decomposition is 1 to 3 min. (auth)

2185 PHOTOCHEMICAL REACTIONS IN ANALYTICAL CHEMISTRY. Communication 14. Photochemical Reactions of Neptunium in Sulphuric Acid Solutions. Nemodruk, A. A.; Bezrogova, E. V.; Ivanova, S. A.; Novikov, Yu. P. Zh. Anal. Khim.; 28: No. 2, 379-382(Feb 1973). (In Russian).

Photochemical reactions of neptunium in different oxidation states under irradiation by a mercury-quartz lamp (PRK-7) were studied depending on the sulfuric acid concentration and the irradiation duration. Neptunium(VI) is obtained quantitatively in 1.5 to 2.0 M H_2SO_4 after the irradiation of neptunium(IV) and neptunium(V) solutions. The irradiation of neptunium(V) and neptunium(VI) in the presence of ethanol results in their reduction to neptunium(IV). (auth)

2186 AMPEROMETRIC DETERMINATION OF CERIUM BY MERCUROSALTS. Acharyan, G. S.; Tarayan, V. M. (Erevan State Univ.). Arm. Khim. Zh.; 25: No. 9, 753-757(1972). (In Russian).

An amperometric method was worked out to determine milligram quantities of cerium(IV) by mercury salts using a platinum rotating microelectrode. The possibilities of titration are discussed according to the cathodic and anodic currents. The region of optimal concentration in the second case is larger and the determination more selective. The determination may be realized in the presence of thorium, titanium, and zirconium. Manganese(VII) interferes. (auth)

2187 USE OF SULFONATED DERIVATIVES OF DIPHENYLCARBAZONE AND DITHIZONE IN ANALYTICAL CHEMISTRY. I. Sulfonated Diphenylcarbazone as Analytical Reagent. Renger, F.; Jenik, J. (Lehrkanzel fuer Analytische Chemie, Pardubice, Czech.). Mikrochim. Acta; No. 2, 199-210(1973). (In German).

The preparation of monosulfonated diphenylcarbazone, which is soluble in water and polar solvents, and its use as a metallochromic indicator are described. Methods were developed for the chelatometric determination of several metals, including Th and Mo, both through direct titration as well as back titration of excess Chelaton 3 with a copper(II) salt. (auth)

2188 STUDIES ON THE MORPHOLINE-N-DITHIOCARBOXYLIC ACID MORPHOLINIUM (MDCM) AS REAGENT IN QUANTITATIVE ANALYSIS. IX. Spectral Photometric Determination of Rhenium. Likussar, W.; Beyer, W. (Univ., Graz). Mikrochim. Acta; No. 2, 211-217(1973). (In German).

A new spectrophotometric method for the determination of small amounts of rhenium is proposed. The method is based on the formation of a rhenium–morpholine-4-carbodithioate complex in strong acidic solution. The effect of diverse ions, including V(VI), was investigated and the method tested statistically. The absorbance is to be measured at 270 nm or 344 nm with corresponding molar absorptivities of $2.92 \cdot 10^4$ and $4.60 \cdot 10^3$ l mole^{-1} cm^{-1}, respectively. (auth)

2189 REACTION OF PHTHALEXON-S AND THYMOL-PHTHALEXON-S WITH SCANDIUM IONS. Karib'yants, M. A.; Cherkesov, A. I.; Alykov, N. M. (Saratov State Pedagogical Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 4, 523-526(1973). (In Russian).

The chemical affinity of Sc ions with the analytical reagents phthalexon-S and thymolphthalexon-S (members of a series of derivatives of hydroxyaminopolycarboxylic acids of triphenylmethane) was studied over a pH range of from 0 to 8 and with excesses of metal and reagents, respectively. Light absorption curves were drawn (400 to 700 nm). A pH of 3 is recommended if the method is used for quantitative determinations of Sc. (KSW)

2190 DETERMINATION OF SCANDIUM, PRASEODYMIUM, AND MAGNESIUM IN MIXTURES BY BIAMPEROMETRIC TITRATION WITH COMPLEXON III. Markhabaev, I. A.; Zhdanov, A. K. (Tashkent State Univ.). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 16: No. 4, 520-522(1973). (In Russian).

Conditions were established for the successive biamperometric titration of a mixture containing Sc, Pr, and Mg without a preliminary separation, and employing Complexon III. The procedure is believed to represent a practical and accurate analytical method. (KSW)

2191 EXTRACTION-PHOTOMETRIC STUDY OF THE REACTION OF ZIRCONIUM WITH MAGNESON IREA. Abasov, G. A.; Gasanov, D. G. Uch. Zap. Azerb. Gos. Univ., Ser. Khim. Nauk; No. 3, 30-33(1971). (In Russian).

With this reagent [5-chloro-2-hydroxy-3-(2-hydroxy-1-naphthylazo)benzenesulfonic acid; I], Zr in a medium of pH 0 to 6 forms a colored complex that can be extracted into butanol and is suitable for the photometric determination of Zr. The absorption maximum of the complex is at 520 nm, and that of I is at 500 nm; measurement is made at 570 nm. Beer's law is obeyed for 9 to 90 μg of Zr in 10 ml of extract. Aluminum, Ge, Pb, Cd, and U(VI) do not interfere; Cu(II), Co, Fe(III), Th, Ga, W(VI), Hf, and F^- do, but Cu and Fe can be masked with mercaptoacetic acid and hydrazine, respectively. (Anal. Abstr.)

2192 ANALYSIS FOR STABLE STRONTIUM IN BIOLOGICAL MATERIALS BY ATOMIC-ABSORPTION SPECTROPHOTOMETRY. Warren, J. M.; Spencer, H. (Veterans Administration Hospital, Hines, IL). Clin. Chim. Acta; 38: No. 2, 435-439(1972).

The method is applicable to urine, diet, and feces. The sample is dried and ashed; the ash is dissolved in the minimum volume of 3N–HCl, $LaCl_3$ solution is added, and the solution is diluted to a known volume. Additive standards are prepared by diluting aliquots of standard Sr solution with the test solution, and the instrument is calibrated at 460.7 nm with standard Sr solution (up to 5 mg of Sr per liter) containing $LaCl_3$. Recovery of Sr added to urine was 94 to 100%, and of Sr added to feces 92 to 101%. (Anal. Abstr.)

2193 CHROMATOGRAPHIC SEPARATION OF MOLYBDENUM, TUNGSTEN, AND NIOBIUM IN FLUORIDE MEDIA. Kurbatova, V. I.; Emasheva, G. N.; Fedorova, N. D. Tr. Vses. Nauch. Issled. Inst. Stand. Obraztsov Spektr. Etalonov; 7: 102-106(1971). (In Russian).

The partition coefficients of W, Mo, and Nb between a solution containing HF and HCl in various concentrations and the anion-exchange resin AV-17 were determined by a static method, and the results were used in developing a method for determining Mo and W in high-temperature alloys. Procedure: Dissolve the sample (0.2 to 0.5 g), in a PTFE vessel, by gentle heating with 20 ml of HCl (1 : 1), add 0.5 ml of HNO_3, and evaporate to dryness on a water bath. Add 5 to 10 ml of HCl to the residue and evap-

orate to moist salts, then dissolve the salts by heating with 2.5 ml of 40% HF. Dilute the solution to 50 ml, and adsorb the Mo and W on AV-17 resin in a PTFE column. Wash the column with 100 ml of N–HF at 1 ml per min. to remove, e.g., V, Fe, Cr, and Ni, and elute W with 500 to 700 ml of 6N–HCl and Mo with 200 to 300 ml of 7N–HNO_3. Determine W and Mo in the respective eluates by photometry or polarography. (Anal. Abstr.)

2194 DIRECT SPECTRAL METHOD OF DETERMINING SMALL AMOUNTS OF NIOBIUM AND TANTALUM IN ROCKS. Korsun, V. I.; Pometun, E. A.; Pachadzhanov, D. N. Zh. Prikl. Spektrosk.; 17: No. 5, 872-875(Nov 1972). (In Russian).

An analytical method for several elements (present as impurities) is described that was based on the selective removal (in the form of volatile compounds) of these elements from a relatively large analytical sample (800 mg). Ftoroplast-4 (fluoroplast-4) was employed as the chemical reagent, and the reaction was accomplished in a large chambered electrode with independent preheating. The method is suitable for the determination of Nb, Ta, Zr, Mo, and Hf in sedimentary rock with an average squared error of duplicate determinations of 10^{-4}%. (tr-auth)

2195 DETERMINATION OF SMALL AMOUNTS OF URANIUM AFTER CONCENTRATION BY EXTRACTION AND ANION EXCHANGE IN A TRI-N-OCTYLPHOSPHINE OXIDE-CONTAINING SOLVENT SYSTEM. Korkisch, J.; Koch, W. (Univ., Vienna). Mikrochim. Acta; No. 1, 157-168(1973). (In German).

A method was developed for the separation of uranium that is based on systematic studies of the behavior of uranium in various water–organic solvent systems containing tri-n-octylphosphine oxide (TOPO) towards various anion forms of the strongly basic anion exchanger Dowex 1, X8. In this procedure, the uranium is extracted from a 1N hydrochloric acid solution containing ascorbic acid into ethyl ether and adsorbed from a mixture consisting of 50 vol. % ether (0.1 N in TOPO), 45 vol. % methylglycol, and 5 vol. % 12 N hydrochloric acid on the ion exchanger (chloride form). Following elution with 1 M hydrochloric acid, the uranium is determined either fluorimetrically or spectrophotometrically by the thiocyanate method. By means of this anion exchange procedure, it is possible above all to separate the uranium from all ions interfering with its fluorimetric or spectrophotometric determination and also from TOPO itself. In particular, consideration is given to the spectrophotometric determination of the uranium in the presence of larger amounts of molybdenum, and a method was worked out for the removal of this element. (auth)

2196 SEPARATION OF MOLYBDENUM FROM TUNGSTEN, VANADIUM, IRON, URANIUM, AND SEVERAL OTHER INTERFERING ELEMENTS BY EXTRACTION OF ITS THIOSULPHATE COMPLEX. Yatirajam, V.; Ram, J. (Univ. of Kurukshetra, India). Mikrochim. Acta; No. 1, 77-86(1973).

A sample solution containing ≤0.8 mg Mo/ml 1.5 N HCl and 32 mg $Na_2S_2O_3 \cdot 5\ H_2O$/ml, is shaken with methyl isobutyl ketone at about 10°C. Molybdenum is stripped off the solvent with ammonia–hydrogen peroxide solution and is determined after the filtration of any insoluble hydroxides and decomposition of hydrogen peroxide and any polythionates. The procedure separates μg to mg of molybdenum from large amounts of Ti(IV), V(V), Cr(VI), Mn(II), Fe(III), Co(II), Ni(II), W(VI), Zr(IV), Ce(IV), U(VI), Bi(V), Sb(III), and Al(III) in a wide variety of samples. (auth)

2197 EFFECT OF COMPOSITION OF THE GASEOUS MEDIUM ON SPECTRAL ANALYSIS OF RARE EARTH OXIDES. Karpenko, L. I.; Grechanovskii, V. P. Zh. Prikl. Spektrosk.; 17: No. 5, 766-769(Nov 1972). (In Russian).

The influence of the type of gaseous environment (air, Ar, N_2, Ar–O_2 mixture, and Ar saturated with H_2O) on the high-voltage spark discharge and on the excitation of the spectra of oxides of the rare earth elements (REE) was studied. The replacement of air by Ar and N_2 enhanced the intensity of the REE spectra. A positive stabilization action was noted when H_2O vapor or O_2 were added to Ar gas. A dependence of the intensity of REE lines on the O_2 content (up to 30%) in Ar was established, yielding a curve with a maximum at 5% O_2. (tr-auth)

2198 MICROTITRIMETRIC DETERMINATION OF URANIUM IN TRIBUTYLPHOSPHATE (30%)-N-DODECANE-NITRIC ACID MEDIUM IN THE PRESENCE OF EXCESS OF IRON, MAGNESIUM, AND ALUMINIUM. Mareska, V.; Sraier, V. (Ustav Jaderneho Vyzkumu, Rez, Czech.). Talanta; 20: No. 4, 411-414(Apr 1973).

A method is described for microdetermination of uranium in aqueous phases containing nitric acid, iron, magnesium, aluminium, and traces of TBP, and in organic phases containing TBP, n-dodecane and nitric acid. Treatment of the organic phase strips the uranium, reduces it to U(IV), and destroys any nitrite present. (auth)

2199 SPECTROPHOTOMETRIC DETERMINATION OF YTTRIUM IN ALUMINUM BASE ALLOYS WITH 1-[(5-METHYL-2-PYRIDYL)AZO]-2-NAPTHOL. Shibata, S.; Sasaki, S.; Ishiguro, Y. (Government Industrial Research Inst., Nagoya, Japan). Mikrochim. Acta; No. 2, 325-329(1973).

A highly sensitive and selective spectrophotometric method was developed for the determination of yttrium in aluminum base alloys. The method is based on the red, water-insoluble complex formed when yttrium and 1-[(5-methyl-2-pyridyl)azo]-2-naphthol (5-Me-β-PAN) react in a pH 9.5 to 11.2 solution. This complex could be extracted into ether (absorption maximum, 530 nm). Beer's law is obeyed up to 1 ppM of yttrium and the molar absorptivity is $6.4 \cdot 10^4\ l \cdot mole^{-1} \cdot cm^{-1}$ at 530 nm. (auth)

2200 DETERMINATION OF URANIUM IN URINE SPECIMENS FOLLOWING THEIR SEPARATION THROUGH ANION EXCHANGE. Korkisch, J.; Steffan, I. (Univ., Vienna). Mikrochim. Acta; No. 2, 273-278(1973). (In German).

A separation method that is generally applicable for uranium in the analysis of urine specimens is described. This is based on the adsorption of the uranium on the strongly basic anion exchanger Dowex 1, X8 from human urine that has been strongly acidified with hydrochloric acid, whereby most of the organic components, phosphoric acid and most mineral urine components are removed. Thus it becomes possible to separate the uranium compounds rapidly and simply without prior evaporation of the urine and destruction of the organic compounds. If need be, the foreign ions that are adsorbed along with the uranium, such as iron and also adsorbed urine coloring materials, are removed through subsequent washing of the resin with a mixture of 50 vol % tetrahydrofurane, 40 vol % methyl glycol, and 10 vol % 6N hydrochloric acid, and the uranium is eluted with 1N hydrochloric acid. The determination of the uranium in the eluate can then be conducted without interference by the fluorometric method. (auth)

2201 SPECTROPHOTOMETRIC DETERMINATION OF ZIRCONIUM WITH SOLOCHROME AZURINE B. S. Tandon, S. N.; Sharma, S. L.; Gill, D. S.; Sabharwal, A. K. (Univ. of Roorkee, India). Zh. Anal. Khim.; 28: No. 2, 382-385(Feb 1973). (In Russian).

Solochrome Azurine B. S. was developed as a selective reagent for the microdetermination of Zr. The conditional stability constant of the 1:2 (Zr: Solochrome Azurine B. S.) complex is 2.63×10^3. The effect of diverse ions was also studied and some of these cations were masked by suitable masking agents. (auth)

2202 TITRIMETRIC METHOD FOR DETERMINING METALS PRECIPITATED WITH CUPFERRONE. Gapchenko, M. V. (Odessa High Naval Engineer School). Zh. Anal. Khim.; 28: No. 2, 361-364(Feb 1973). (In Russian).

A possibility was shown for titrimetric analysis of the precipitates of Ti(IV), V(V), Zr(IV), and Fe(III) cupferronates. A metal cupferronate precipitate is dissolved in acetone, an excess of a standard vanadium(II) solution is added for reducing the cupferronate, the residual vanadium(II) amount is titrated by a solution of ammonium–iron alum in the presence of safranine. (auth)

2203 SPECTROPHOTOMETRIC DETERMINATION OF RUTHENIUM IN ALKALINE MEDIA BY POLYHYDROXY COMPOUNDS. Yankauskas, Yu. Yu.; Norkus, P. K. (Inst. of Chemistry and Chemical Tech., Vilnyus, USSR). Zh. Anal. Khim.; 28: No. 2, 333-336(Feb 1973). (In Russian).

The interaction of ruthenium compounds of the oxidation state ≥6 with polyhydroxy compounds (tartrate, ethylene, glycol, glycerin, mannitol, sorbitol and dulcitol) in a strongly alkaline medium results in the reduction of the element to Ru(III) followed by the formation of stable complex compounds which absorb in the ultraviolet region (λ_{max} = 320 to 350 nm). A possibility was shown of using ruthenium complexes with polyhydroxy-compounds for spectrophotometric determination of ruthenium. (auth)

2204 EXTRACTION-SPECTROPHOTOMETRIC DETERMINATION OF YTTRIUM SUBGROUP ELEMENTS. Poluektov, N. S.; Makarenko, O. P.; Kirillov, A. I.; Lauer, R. S. (Irkutsk State Univ., USSR). Zh. Anal. Khim.; 28: No. 2, 285-289(Feb 1973). (In Russian).

The solvent extraction of complexes of rare earth elements (REE) with quinalizarin (QA) and benzoic acid (BA) into n-butanol was studied. At pH 9.7 to 10.4 complexes with a ratio of REE : QA : BA = 1 : 1 : 2 are extracted. A method was developed for determining REE of the yttrium subgroup in a mixture with REE of the cerium one. The sensitivity of the determination is 0.5 to 1.0% of an element in a mixture of REE of the cerium group oxides. The error is not more than 3.3%. (auth)

2205 DETERMINATION OF RARE EARTH ELEMENTS WITH ERIOCHROME BLACK T IN THE PRESENCE OF DIPHENYLGUANIDINE. Akhmedli, M. K.; Granovskaya, P. B.; Neimatova, R. A. (Baku State Univ.). Zh. Anal. Khim.; 28: No. 2, 278-284 (Feb 1973). (In Russian).

Rare earth elements form colored three-component compounds with eriochrome black T and DFG. The reaction is contrast, sensitive and selective. The compounds are extracted into alcohols by 96 to 98%, optimal pH for the complex formation is 6.35 to 6.80. Maximum absorption of the reagent extract is at 650 to 660 nm, that of the complex extracts is at 550 to 600 nm. The molar extinction coefficients for the complexes of the yttrium subgroup elements are 26,100 to 34,500, for those of the cerium ones they are 7100 to 23,000. The components interact at a ratio of 1:2:2. The equilibrium constants for the reaction are $(2.5 - 5) \times 10^{-5}$. An extraction-photometric method for determining the yttrium subgroup elements in the presence of cerium ones was developed. The sensitivity is 0.1 μg/ml, the accuracy is ±2%. (auth)

2206 REACTIONS OF RARE EARTH ELEMENTS WITH BIS-AZO DERIVATIVES OF CHROMOTROPIC ACID IN THE PRESENCE OF COMPLEXONES. Savvin, S. B.; Petrova, T. V.; Romanov, P. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Anal. Khim.; 28: No. 2, 272-277(Feb 1973). (In Russian).

The color reactions of rare earth elements with the reagents carboxynitrazo and carboxyanthranylazo in the presence of complexones were studied. The use of complexones enables not only an increase in the selectivity but in some cases the sensitivity of the determination of individual rare earths. (auth)

2207 AZOPHOSPHON [2-(2,4-DIHYDROXYPHENYLAZO)-BENZENEPHOSPHONIC ACID], A NEW REAGENT FOR THE PHOTOMETRIC DETERMINATION OF SCANDIUM. Lukin, A. M.; Vysokova, N. N.; Bolotina, N. A. Tr. Vses. Nauch. Issled. Inst. Khim. Reaktivov; No. 33, 162-169(1971). (In Russian).

Azophosphon (I) reacts with Sc (down to 0.04 μg per ml) to form a 1:1 complex. The optimum pH range is 0.75 to 3.5, and the stability of the complex is increased by the addition of 70% of ethanol or acetone. The absorption maximum of the complex and I are at 415 and 385 nm, respectively, and the corresponding ϵ values are 13,640 and 2780. In the determination of Sc with I, negligible interference is caused by large amounts of various metals and anions, or by 5-fold amounts of Ti or Hf, 2.5-fold amounts of Mo, Zr, or Be or a 0.5-fold amount of Th. A procedure is described for the determination of Sc (equiv. to 0.004 to 0.03% of Sc_2O_3) in wolframite; the extinction is measured at 470 nm, as I shows little absorption at this wavelength. (Anal. Abstr.)

2208 ANALYSIS OF ZIRCONIUM IN HIGH-ALLOY STEELS. Blazejak-Ditges, D. (Mannesmann AG, Duesseldorf). Arch. Eisenhuettenw.; 43: No. 12, 887-888(Dec 1972). (In German).

The methods of determining zirconium as described in the literature and their difficulties are reviewed. Improvement of the photometric analysis with Arsenazo III and its use in the case of high-alloy steels is described. The application of this method to the determination of lower zirconium contents without preseparating is discussed. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 2385, 2646, 2668, and 2806.

2209 AECL-4313) BURNUP DETERMINATION OF A FUEL STRING BY CHEMICAL AND ISOTOPIC ANALYSIS. Durham, R. W.; Corriveau, V. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Feb 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

The burnup of six fuel bundles irradiated in NRU was determined by chemical and isotopic analysis. The concentration of uranium and plutonium in solution was determined by controlled potential coulometry and 2π alpha counting respectively. Alpha spectra obtained from sublimed plutonium sources provided the $^{238}Pu/^{239}Pu + ^{240}Pu$ ratios needed for corrections. Mass spectrometric analyses were done on separated uranium and plutonium solutions. The number of uranium and plutonium fissions were calculated from the ^{235}U depletion and the Pu/U ratio. (auth)

2210 (ANL-7979) CHEMICAL ENGINEERING DIVISION BURNUP, CROSS SECTIONS, AND DOSIMETRY SEMIANNUAL REPORT, JULY-DECEMBER 1972. Larsen, R. P.; Dudey, N. D.; Crouthamel, C. E.; Levenson, M.; Vogel, R. C. (Argonne National Lab., Ill.). Mar 1973. Contract W-31-109-eng-38. 22p. Dep. NTIS.

Research and development efforts of the burnup, cross sections, and dosimetry programs in the Chemical Engineering Division of Argonne National Laboratory are reported for the period July to December 1972. Work is reported in the following areas: (1) measurements of the ^{235}U and ^{239}Pu thermal fission yields of short-lived gamma-active nuclides relative to the ^{137}Cs yields and comparison of the thermal and fast yields of these nuclides with existent fission-yield values for their stable daughters, (2) development and evaluation of a nondispersive x-ray spectrometer for the determination of rare-earth fission products, uranium, and plutonium, (3) measurements of tritium yields for LMFBR fuel materials, (4) measurements of fission rates by solid-state track recorders and by foil activation, and (5) evaluation of methods for correlating radiation-damage effects with the irradiation environment. (auth)

2211 (KFK-1703) DETERMINATION OF URANIUM IN AQUEOUS SOLUTIONS BY MEANS OF γ-ABSORPTIOMETRY. Cristallini, O.; Gantner, E.; von Baeckmann, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Nov 1972. 27p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

A method was developed for the determination of uranium in aqueous solutions acidified with nitric acid, which were of various densities and had various contents of aluminum nitrate. The method is based on the principle of gamma absorptiometry using two monoenergetic gamma radiations whose energies include the K-absorption edge of uranium. Two measurements must be carried out for each of the two gamma energies, i.e., first the measurement of the intensity of the penetrating radiation for the cell filled with water and, secondly, the measurement of the intensity of the penetrating radiation for the cell filled with the sample solution. Moreover, the k-factor for the arrangement used must be determined in advance by means of a correction standard. These measurements and the data from the calibration curve can then be used to determine the uranium concentrations in the sample solutions. Matrix effects play no role under the conditions of measurement applied. The method was studied for solutions with uranium concentrations in the range of 1 to 20 g of uranium/l, the concentration of nitric acid and of aluminum nitrate being varied. In the range of concentration investigated, the relative standard deviation of an individual measurement was 0.71%. (auth)

2212 DETERMINATION OF LEAD, URANIUM, THORIUM, AND THALLIUM IN SILICATE GLASS STANDARD MATERIALS BY ISOTOPE DILUTION MASS SPECTROMETRY. Barnes, I. L. (National Bureau of Standards, Washington, D. C.); Garner, E. L.; Gramlich, J. W.; Moore, L. J.; Murphy, T. J.; Machlan, L. A.; Shields, W. R.; Tatsumoto, M.; Knight, R. J. Anal. Chem.; 45: No. 6, 880-885(May 1973).

A set of four standard glasses was prepared and doped with 61 different elements at the 500-, 50-, 1-, and 0.02-ppM level. The concentrations of lead, uranium, thorium, and thallium were determined by isotope dilution mass spectrometry at a number of points in each of the glasses. The results obtained from independent determinations in two laboratories demonstrate the homogeneity of the samples and that precision of the order of 0.5% (95% L. E.) may be obtained by the method even at the 20-ppB level for these elements. The chemical and mass spectrometric procedures necessary are presented. (auth)

2213 DETERMINATION OF THE TOTAL AMOUNT OF OXYGEN ATOMS IN SILICON OXIDE SURFACE LAYERS BY THE NUCLEAR REACTIONS $^{16}O(d,p_1)^{17}O$ AND $^{16}O(d,\alpha)^{14}N$. Turos, A. (Inst. of Nuclear Research, Warsaw); Wielunski, L.; Olenski, J. Phys. Status Solidi (a); 16: No. 1, 211-217(16 Mar 1973).

The nuclear reaction $^{16}O(d,p_1)^{17}O^*$ is used for the measurement of the total amount of oxygen atoms in thermally grown SiO_2 layers on silicon. The method consists in measuring the proton yield from the $^{16}O(d,p_1)^{17}O^*$ reaction, induced by a bombardment of the sample with 900-keV deuterons. The absolute value of the amount of oxygen atoms is obtained by means of the reference standard of Al_2O_3. The independent method of the thickness determination of SiO_2 surface layers by means of the nuclear reaction $^{16}O(d,\alpha)^{14}N$ is described and its application to the $^{16}O(d,p_1)^{17}O^*$ data correction is indicated. 5 figures. (auth)

2214 APPLICATION ON NON-PHOTOGRAPHIC NUCLEAR-TRACK REGISTRATION IN SOLIDS. Piesch, E. (Kernforschungszentrum, Karlsruhe, Ger.). G-I-T (Glas- Instrum.-Tech.) Fachz. Lab.; 16: No. 7, 810-816(1972). (In German).

The tracks produced by nuclear particles in polymeric materials are described, and their uses in, e.g., neutron dosimetry, radiography, micro-determination of U, Th and Pu, dating of minerals, and extra-terrestrial monitoring of cosmic rays are reviewed. (37 references) (Anal. Abstr.)

2215 SIMPLE METHOD FOR DETERMINATION OF RADIOIODINE. Dobosz, E. (Dept. of Radiation Hygiene, Warsaw). Radiochem. Radioanal. Lett.; 13: No. 5-6, 381-384(30 Apr 1973).

A sensitive method was developed for the determination of radioiodine in environmental samples. ^{131}I is separated from water solution of mineralized samples by extraction with carbon tetrachloride and then is deposited on a thin film of anion-exchange resin. The resin film is mounted on a perforated counting tray enabling the filtration of sample and then measuring its activity in low-level anticoincidence beta-counter. Preparation of one sample for counting requires approximately one hour. The chemical yield of the method was found to be 99%. (auth)

2216 ALPHA PARTICLE BACK-SCATTERING FOR THE STUDY OF PRINTED AND COATED LAYERS. Eriksson, L.; Fladda, G.; Johansson, P A. (Swedish Forest Products Research Lab., Stockholm). J. Radioanal. Chem.; 12: No. 1, 287-300(Oct 1972).

International meeting on chemical analysis by a charged particle bombardment; Namur, Belgium (6 Sep 1971).

A 1.8 MeV He-beam from a Van de Graaff accelerator was used to demonstrate that back-scattering techniques can be usefully applied to study certain problems related to the interaction between coatings and paper substrates and between printing inks and coated or uncoated paper or plastic substrates. In particular, information on distribution profiles of various components can be obtained. The technique and some of its practical aspects are briefly described. (auth)

2217 COMPARISON OF COMBUSTION AND LOW BETA COUNTING METHODS FOR THE DETERMINATION OF LOW LEVELS OF ^{14}C ACTIVITY IN ANIMAL TISSUE. Tyler, T. R.; Chapin, L. R.; Alvaro, R. F.; Cox, J. L. (Merck, Sharp and Dohme Research Labs., Rahway, NJ). J Radioanal. Chem.; 12: No. 2, 475-482(Dec 1972).

Low β counting was compared to combustion and liquid scintillation counting for detection of low levels of ^{14}C activity in animal tissues. In two separate experiments tissues from sheep and from pigs were analyzed. The first experiment utilized tissues from sheep into which a known amount of ^{14}C radioactivity was added. Combustion analysis gave somewhat higher recovery than low β-analysis, 92.8% compared to 85.7%. Statistical analysis indicated that the greatest source of random variation was in sampling. In the second experiment tissues from pigs given a ^{14}C-labeled drug were analyzed. Sampling was again the greatest source of random error, however, it was greatly reduced over that in the first experiment. This was attributed to higher levels of radioactivity or to more homogeneous incorporation of radioactivity into tissues. The analytical performance of the two methods was essentially the same, and a decision as to the best method for tissue residue studies is dependent on other considerations. (auth)

2218 DETERMINATION OF SODIUM-24 IN ATMOSPHERIC PRECIPITATION. Yasyulenis, R. Yu.; Luyanas, V. Yu.; Kekite, V. P. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 673-674(1972).

Translated from Radiokhimiya; 14: No. 4, 650-651(1972).

A method is described for measuring ^{24}Na in rain water based on a combination of ion exchange concentration and measurement of ^{24}Na with the aid of a $\beta-\gamma$ coincidence setup. The method possesses great selectivity, permits a reliable identification of ^{24}Na, and a measurement of its concentration up to 50 atoms/liter. (DHM)

2219 RAPID METHOD OF OBSIDIAN CHARACTERIZATION BY INELASTIC SCATTERING OF PROTONS. Coote, G. E.; Whitehead, N. E.; McCallum, G. J. (Inst. of Nuclear Sciences, Lower Hutt, N. Z.). J. Radioanal. Chem.; 12: No. 2, 491-496 (Dec 1972).

A new and nondestructive method of characterising obsidians for archaeological purposes is described. Sodium, fluorine, and aluminium are determined by inelastic scattering of a beam of protons from a 3 MeV Van de Graaff accelerator. Irradiation and counting are simultaneous and take five minutes per sample, while data analysis is automated and requires about 20 sec per sample. (auth)

2220 QUANTITATIVE METHOD FOR THE ANALYSIS OF TERNARY SYSTEMS. Cecal, A. (Al. I. Cuza Univ., Iasi). Radioanal. Chem.; 12: No. 2, 529-534(Dec 1972).

A rapid determination of the concentrations of K^+, Co^{2+}, and Pb^{2+} in a ternary system is reported. The method used is based on the measurement of the activity of the solution containing a labeled component, and on the determination of the intensity of β-rays back-scattered in the system. Standard curves are drawn, by means of which the unknown concentrations of the components in the ternary system can be established. The precision of the method is between 0.5 and 2%. (auth)

2221 INFLUENCE OF THE STATISTICAL ERROR IN RADIOACTIVITY COUNTING ON THE PRECISION OF ISOTOPE DILUTION ANALYSIS. II. Kyrs, M. (Nuclear Research Inst., Rez, Czech.); Kandiyoti, R.; Vrana, T. J. Radioanal. Chem.; 12: No. 2, 505-512(Dec 1972).

Three types of direct isotope dilution analysis (IDA) are mathematically treated: substoichiometric dilution analysis, the determination of sorbent capacity, and direct IDA with a constant amount of substance lost in the separation step. Tables and graphs are given for an easy determination of the amount of radioisotope W_0 to be added and for the estimated error involved. (auth)

2222 TRITIUM ANALYSIS WITH AN ETHANE-FILLED PROPORTIONAL COUNTER. Povinec, P.; Chudy, M.; Seliga, M.; Saro, S.; Szarka, J. (Comenius Univ., Bratislava). J. Radioanal. Chem.; 12: No. 2, 513-518(Dec 1972).

An apparatus for natural tritium concentration measurement using an ethane-filled proportional counter with anticoincidence shielding is described. The counter characteristics and the counter calibration with internal tritium and external ^{137}Cs standards are discussed. Results of tritium analysis of Bratislava rains are presented. (auth)

2223 X-RAY FLUORESCENCE ANALYSIS OF HETEROGENEOUS MATERIAL: EFFECTS OF GEOMETRY AND SECONDARY FLUORESCENCE. Gardner, R. P.; Betel, D.; Verghese, K. (North Carolina State Univ., Raleigh). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 135-146(Mar 1973).

Some simple mathematical models for x-ray fluorescence analyzers, including two new ones, are derived here by a simple unified method. Variable geometry and secondary fluorescence are added to these models for greater rigor. The various models with and without these modifications are evaluated using experimental data. The addition of variable geometry and secondary fluorescence are shown to make significant improvement in the models. (auth)

2224 RADIOCHEMICAL ANALYSIS OF THE PRIMARY COOLANT OF WATER-COOLED NUCLEAR REACTORS BY MEANS OF A Ge(Li)-DETECTOR. Neeb, K. H.; Neidl, H.; Stoechert, H. (Siemens AG, Erlangen, Ger.). Siemens Forsch. Entwicklungsber.; 1: No. 4, 350-354(1972). (In German).

A gamma-spectroscopic method for the evaluation of the fission and activation products which are mainly occurring in the primary reactor coolant water is proposed. Using some simple separation procedures for the elimination of unwanted peak coincidences in the spectra, the sample is flushed with argon or nitrogen and the spectra taken before and after this treatment are compared. Iodine isotopes are removed by solvent extraction, and suspended matter by filtration through membrane filters. Heavy metals can be precipitated by means of carriers with subsequent filtration separation. Proposals are made for the measurement setup, the size of the detector, and the evaluation of the gamma spectra. (GF)

2225 RAPID METHOD FOR THE DETERMINATION OF RADIOSTRONTIUM IN WATER. Haberer, K.; Stuerzer, U. (Stadwerke, Wiesbaden, Ger.). Gas-Wasserfach; 112: No. 4, 186-187(1971). (In German).

A previously described method (Analyt. Abstr., 1971, 20, 2138) for the separation of bivalent cations by use of ion exchange filters (SA-2 paper) was extended to samples containing mixtures of ^{90}Sr and radioactive Ba, by selective extraction of the ^{90}Sr with buffered weakly acidic Na_2CrO_4 solution. In this method, the Ba^{2+} ions are retained by the SA-2 filter as difficultly soluble $BaCrO_4$, and a 90% recovery of ^{90}Sr is effected, the total time involved being ≃1 hr. (Anal. Abstr.)

2226 ROUTINE DETERMINATION OF ^{137}Cs CONTAMINATION IN FOODS. Szentesi, G. Elelmiszervizsgalati Kozlem.; 17: No. 5-6, 263-268(1971).

Two possibilities of the routine measurement of ^{137}Cs contamination in foods were compared. The nuclear measurements were carried out by means of an energy-selective counter, a scintillation-type sensing probe with gamma detector, and a lead column. One of the tested methods is based on the direct spectrometry of the ash of the food sample, the other being founded on the previous binding of the cesium ion content of the ash by ammonium phosphomolybdate followed by spectrometric analysis. The latter method proved to be more accurate. (Hung. Tech. Abstr.)

2227 DETERMINATION OF AMERICIUM-241 AND AMERICIUM-243 IN THE PRESENCE OF LARGE AMOUNTS OF CURIUM AND FISSION PRODUCTS BY THE METHOD OF ALPHA-GAMMA COINCIDENCE. Myasoedov, B. F.; Chernov, G. M.; Myagkov, A. P.; Lebedev, I. A. Zh. Anal. Khim.; 28: No. 2, 294-300(Feb 1973).

A possibility was studied of determining ^{241}Am and ^{243}Am in

solutions containing Cm isotopes and fission products without radiochemical separation of Am by measuring $\alpha-\gamma$-coincidence spectra for samples of these solutions. Such a method can be used for the determination of down to 3×10^{-3}% (by α-activity) ^{243}Am in ^{244}Cm in the presence of foreign γ-radiation with the intensity of 10^5 quantum/min. Minimum determinable ratio of $^{243}Am/^{244}Cm$ (by α-activity) increases to about 10^{-2} if the foreign γ-radiation intensity is 10^6 quantum/min. (auth)

2228 EXTENSION OF RAGHAVAYYA'S METHOD FOR THE DETERMINATION OF RADON IN WATER. Kobal, I.; Kristan, J. (Univ., Ljubljana, Yugoslavia). Mikrochim. Acta; No. 2, 219-224(1973).

The extension of Raghavayya's method for the determination of ^{222}Rn in water is described. Raghavayya's method of bubbling was supplemented by two new computational methods. They are based on more successive bubblings of nitrogen through a water sample. The gas collected in scintillation cells is measured for α activity. The activity of each portion of the gas decreases exponentially and fits more closely the exponential line obtained theoretically. The results obtained by Raghavayya's original equation and by the two new proposed equations are compared with known values from standard solutions. (auth)

2229 RAPID DETERMINATION OF RADIOACTIVE CERIUM IN WATER SAMPLES. Haberer, K.; Stuerzer, U. Gas-Wasserfach, Wasser-Abwasser; 113: No. 3, 122-123(1972). (In German).

The separation and determination of radioactive cerium in water described here is a variation of the method of the determination of the sum of radioactive cations used by Albu-Yaron e.a. A combination of different adsorption-elution steps by means of cation and anion exchange is followed by the precipitation of cerium(IV) as iodate. The cerium yield is at least 90%. The time required for the separation including the enrichment is about 1 hr. (GE)

2230 DETERMINATION OF THE RADIOCHEMICAL PURITY OF METHANOL-^{14}C, FORMALDEHYDE-^{14}C, AND ETHANOL-^{14}C BY RADIO GAS CHROMATOGRAPHY. Sokolowska, A. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 13: No. 5-6, 287-299(30 Apr 1973).

Radiogas chromatography was applied for determining the radiochemical purity of labeled methanol-^{14}C, formaldehyde-^{14}C and ethanol-1-^{14}C obtained by chemical synthesis. Radioactive compounds after gas-chromatographic separation were converted to $^{14}CO_2$, and their activity was measured in a proportional, flow, window counter. (auth)

Separation Procedures

Refer also to abstracts 2420, 2431, and 2440.

2231 (CEA-R-4350) LIQUID-LIQUID EXTRACTION: TRANSIENT REGION STUDIES. Effect of Hydrodynamics on the Operation of the Equipment. Demarthe, J. M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Feb 1973. 49p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

Thesis. Submitted to Paris Univ. (France).

The purification of a chemical species using the solvent extraction method is very widespread in industry. Some important improvements to this technique are proposed. The extraction is generally effected using mixer-settlers of known equilibrium and transient behavior characteristics. The response of such a system to a disturbance depends upon the mixer and the settler. The subject is treated in three parts. In the first part, a model is proposed in which the system incorporates perfect mixers; this system does not provide an accurate description of the behavior the mixer-settler. In the second part, a simulation method is used to develop a general model for the settler. This model takes into account the real hydrodynamic processes established using tracers, and introduces the idea of auxiliary flow; this new parameter enables convection within the system to be evaluated and is calculated from the theory of jets. In the third part, the previously obtained results are used to establish a model for the operation of the complete battery when submitted to a given disturbance in the flow rate or concentration. This model is presented in the form of a computer program. It is then shown that the drop in yield of a mixer-settler battery fed with a periodic flow is due to the spreading out of the distributions representing the times spent by the two phases in the mixer. (auth)

2232 (CONF-721010-71) RADIOCHEMICAL SEPARATIONS BY ADSORPTION ON SOME OXIDES OF IVB AND VB GROUPS. Ganzerli-Valentini, M. T.; Meloni, S.; Maxia, V.; Pisani, U. (Pavia Univ. (Italy)). 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The interaction between titanium dioxide, niobium pentoxide, and tantalum pentoxide and 55 elements was studied by batch experiments in nitric acid. The variation of the distribution coefficients with nitric acid concentration is presented and discussed. The adsorption mechanism for certain ions was also investigated. Column experiments were carried out to check the practical use of the investigated oxides in radiochemical separations. A ^{99m}Tc generator based on the use of TiO_2 is also presented. (auth)

2233 (COO-1515-42) FIXING CATION INTERACTION WITH BLISTER-LIKE OSMOTIC SWELLING ON VERMICULITE CLEAVAGES. Sridhar, K.; Jackson, M. L. (Wisconsin Univ., Madison. Dept. of Soil Science). 1972. 30p. Dep. NTIS $3.50.

The shrinkage of osmotically swollen natural and artificial blisters on vermiculite cleavages by exchange saturation with fixing cations such as Cs^+, Rb^+, NH_4^+, and K^+ was investigated by replica electron microscopy. Micaceous vermiculites from South Africa, Montana, and Utah, and a saponitic, vermiculitic phlogopite from Kansas were studied. Incomplete collapse of either the natural or artificially produced blisters occurred with Cs^+, Rb^+, and NH_4^+ saturation, while K^+ saturation completely collapsed the artificially produced blisters but not the natural blisters. The reason for incomplete collapse of the blisters with Cs^+, Rb^+ and NH_4^+ was the incomplete replacement (trapping in the flakes) of interlayer hydrated cations such as Na^+, shown by electron probe microanalysis. Much less trapping occurred with K^+ saturation. The amounts of Na^+ entrapment increased with increasing size and decreasing hydration of cations, i.e., $Cs^+ > Rb^+ > NH_4^+ > K^+$. Semiquantitative determination by electron probe microanalysis of Na^+ entrapment in vermiculite flakes near the edge revealed that 1N CsCl entrapped as much as 45.6 percent while 1N KCl entrapped only 7.5 percent. In general, more Na^+ was entrapped by 1N solutions than by dilute solutions. With 0.01N KCl solution, the Na^+ entrapment was only 4.4%. The amount of Na^+ entrapment at the center of the macroflakes was less than at the edge. Shrinkage of artificial blisters by K^+ could thus be attributed to its more effective removal of the interlayer hydrated cations, whereas the other fixing cations were less effective. Natural blisters on vermiculite from Libby, Mont. were not completely collapsed even by K^+, apparently because the layer charge density was too low in the blister areas. (auth)

2234 (FRNC-TH-314) STUDY OF ION EXCHANGE EQUILIBRIA IN WATER-HEXAMETHYLPHOSPHOROTRIAMIDE (HMPT) MEDIA. Application to the Separation of Rare Earths. Imbert, J. L. (Lyon Univ. (France)). 1971. 97p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis.

A description is given of the various physical and chemical properties of hexamethylphosphorotriamide (HMPT) in view of its applications to ion exchange processes and various experimental techniques. The effect of temperature (20° to 40°C) on ion exchange in HMPT-water and HMPT-water-HCl (0.1M) media was investigated for certain transition metals, Co, Zn, and Cd. The exchange of Fe^{3+}, Cd^{2+}, and Zn^{2+} ions on cation resins (DOWEX 50W×8) in HMPT-water-HNO_3 media was studied and comparisons were made between the exchange of these ions in HMPT-HCl and HMPT-HNO_3 media. The effect of the acidity of HNO_3 and HCl on ion exchanges in HMPT-water media were compared by measuring the conductivities of the HMPT-water-HCl, and HMPT-water-HNO_3 solutions. In HCl media stabilization of the chlorocomplexes formed between these cations and the chloride ions occurs and consequently the disappearance of the affinity for the cation resin. On the other hand, fixing on anionic resin is possible. The behavior of rare earths Nd^{3+}, Eu^{3+}, Tb^{3+}, Tm^{3+}, and Yb^{3+} on anion DOWEX 1×8 resin in HMPT-HCl and HMPT-HNO_3 media was then studied. Rare earths are only very slightly adsorbed by anion resins in HMPT-HCl media, although they are adsorbed in HMPT-HNO_3 media. Light rare earths (Nd) are only slightly retained by the resin, while heavy rare earths (Tb, Tm, and Yb) are strongly retained. Eu presents characteristics in between these extremes. The separations proposed on anion resins are, however, not very interesting. Studies of the behavior of Nd, Sm, Eu, Gd, Tb, Tm and Yb on DOWEX 50 WX8 cation resin in HMPT-water, HMPT-HCl, and HMPT-HNO_3 media demonstrated that an enhanced selectivity can be obtained with HCl. Eu and Tm are most strongly retained in the 40 to 60% HMPT zone and Eu is the only element to be retained in the 75 to 80% HMPT zone. (auth)

2235 COMPLETE PAPER-ELECTROPHORETIC SEPARATION OF A MIXTURE OF Fe(III), Al(III), Ni(II), Co(II), AND Mo(VI) USING PYRIDINE-ACETIC ACID BUFFER. Chakrawarti, P. B.; Gupta, S. K. (Holkar Science Coll., Indore, India). Vijnana

Parishad Anusandhan Patrika; 15: No. 3, 177-180(Jul 1972). (In Hindi).

A complete separation of a mixture of Fe(III), Al(III), Ni(II), Co(II) and Mo(VI), without overlapping and minimum spreading of bands, was effected using acetic acid and pyridine buffer of 6.5 pH as an electrolyte and a voltage drop of 0.718 volts/mm. The apparatus employed is the simple LKB (Switzerland) 3276 model electrophoresis tank. Although a clear separation is perceptible in half an hour, optimum results are obtained when the run is made for a duration of 2 hours. (auth)

2236 QUANTITATIVE EXTRACTIVE SEPARATION OF ZIRCONIUM AND TITANIUM WITH THE HELP OF N-HEPTYLARSONIC ACID. Pietsch, R.; Gilani, P. T. (Univ., Graz). Anal. Chim. Acta; 64: No. 3, 345-351(May 1973). (In German).

Zirconium and titanium can be easily and quickly extracted from ~0.5 M hydrochloric, nitric, or sulfuric acids by means of n-heptylarsonic acid in chloroform. The metal can be determined gravimetrically, or after some pretreatment, titrimetrically or photometrically. The extraction allows a quantitative separation from a large number of elements. The results obtained for technical products such as alloys and glass are compared with results of standard methods. (auth)

2237 SELECTION OF CHROMATOGRAPHIC SYSTEMS FOR SEPARATING RARE-EARTH MIXTURES BY PARTITION CHROMATOGRAPHY. Babayan, Kh. S.; Varshal, G. M. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Arm. Khim. Zh.; 25: No. 10, 844-850(1972). (In Russian).

The possibility of using di-(2-ethylhexyl) orthophosphoric acid (HDEHP) for analyses of rare earth mixtures by paper chromatography was studied. It was shown that although HDEHP as an extraction agent provides a high separation factor for neighboring rare earth elements it is little suited for analytical purposes. (auth)

2238 RAPID ION-EXCHANGE SEPARATION OF RADIOACTIVE SULFUR ANIONS. Owens, C. W. (Univ. of New Hampshire, Durham). Radiochem. Radioanal. Lett.; 13: No. 5-6, 325-327(30 Apr 1973).

An ion-exchange separation of sulfide, sulfite, sulfate, thiosulfate, and thiocyanate is described which requires less than 90 minutes and which permits continuous monitoring of the radioactivity of the eluted fractions. (auth)

2239 Br^--I^- SEPARATION ON THE INORGANIC FILTER Fe_2O_3. Guillaume, M. (Univ., Leige). Radiochem. Radioanal. Lett.; 13: No. 5-6, 319-324(30 Apr 1973). (In French).

A method for rapid and efficient separation of Br^- and I^- ions in aqueous solution is described. The use of a small column filled with an inorganic exchanger such as Fe_2O_3 enables the measurement of the activity of only Br^- on the column itself after complete elution of I^- ions. (auth)

2240 SEPARATION OF RARE GASES BY MEMBRANES. Kimura, S. (Tokyo Univ.); Nomura, T.; Miyauchi, T.; Ohno, M. Radiochem. Radioanal. Lett.; 13: No. 5-6, 349-354(30 Apr 1973).

Permeabilities of rare gases, He, Ar, Kr, Xe, through silicone rubber and cellulose acetate membranes are measured. Since the order of the permeability is completely reversed for the two kinds of membranes, a new separation scheme having a large separation factor can be set up. (auth)

2241 COPRECIPITATION OF HEPTAVALENT NEPTUNIUM ON INORGANIC CARRIERS. Novikov, Yu. P.; Ivanova, S A.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Radiochem. Radioanal. Lett.; 13: No. 5-6, 355-360(30 Apr 1973).

The coprecipitation of heptavalent neptunium from alkaline solutions on various metal hydroxides and other carriers was studied as a function of the alkali concentration, the coprecipitator content, the procedure of reagent addition and time. The mechanism of coprecipitation is discussed in detail. (auth)

2242 ELECTROFOCUSING OF INORGANIC IONS. Principle and General Theory. Shvedov, V. P.; Semanov, G. N. (Leningrad Inst. of Tech.). J. Radioanal. Chem.; 12: No. 2, 413-419(Dec 1972).

The mechanism of formation of a pH gradient along a paper strip is discussed. An equation was derived making possible the calculation of the pH along the carrier. An equation is given relating the pH and the place of ion focusing to the stability constant. The distances between the focused zones were estimated for the system Fe-Sr-Y. A comparison of calculated and experimental data for the systems Ca-Sr, Cu-Co, and Ce-Pr-Na-Sm is given. (auth)

2243 BEHAVIOR OF RADIOACTIVE ELEMENTS IN SORPTION SYSTEMS WITH HUMUS SUBSTANCES. III. Sorption of ^{137}Cs From Aqueous Solutions with Activated Charcoal in the Presence of Humic Acids. Shchebetkovskii, V. N.; Tarlakov, Yu. P.; Egorov, Yu. M. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 654-655(1972).

Translated from Radiokhimiya; 14: No. 4, 636-637(1972).

The presence of humic acids in solutions, reducing the sorption of ^{137}Cs by activated charcoal, does not change the ion exchange nature of the absorption of the sorbate by the sorbent. The results of an investigation of the behavior of ^{137}Cs in sorption systems containing charcoal and the anion exchange resin IA-1 demonstrates the absence of interaction between cesium and humic acid in the solutions. (auth)

2244 EXTRACTION OF ZIRCONIUM-95 AND HAFNIUM IN THE FORM OF MIXED COMPLEX COMPOUNDS AND THE ZIRCONIUM CONTENT IN THESE COMPOUNDS. Haier, R. G.; Rudenko, N. P. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 667-669(1972).

Translated from Radiokhimiya; 14: No. 4, 645-647(1972).

The extraction of zirconium and hafnium by chloroform solutions of diantipyrylpropylmethane (DP) and 1-nitroso-2-naphthol (1-N-2-N) and diantipyrylpropylmethane and thenoyltrifluoroacetone (HTTA) as a function of the hydrochloric acid concentration was studied. A higher degree of extraction than with each of the reagents taken individually was established. It was established by the method of displacement of equilibrium that in the extractable compounds the ratios H_2DP^{2+} : Me : 1-N-2-N and H_2DP^{2+} : Me : TTA are equal to 1 : 1 : 2. The zirconium content was determined by neutron activation analysis in the compounds of zirconium with two reagents (with DP and 1-N-2-N) isolated from aqueous medium. (auth)

2245 FLOTATION OF CERIUM IONS FROM DILUTED SOLUTIONS. Pustovalov, N. N.; Pushkarev, V. V.; Verezyuk, V. V.; Migalatii, E. V. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 670-672(1972).

Translated from Radiokhimiya; 14: No. 4, 648-650(1972).

The interaction of micro- and macroquantities of cerium with sodium alkylsulfate possessing different lengths of the hydrocarbon chain in the process of ionic flotation was studied. It was shown that the degree of extraction of cerium from aqueous solutions into the foam product is influenced by its state in solution, as well as by the concentration and length of the hydrocarbon chain of the sodium alkylsulfate used. (auth)

2246 ELECTROCHEMICAL OXIDATION OF Pr(III) TO Pr(IV). Afanas'ev, Yu. A.; Khanaev, E. I.; Andrushchenko, O. V. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 677(1972).

Translated from Radiokhimiya; 14: No. 4, 654(1972).

An electrochemical method of oxidation of Pr(III) to Pr(IV) in nitric acid solution on a platinum anode was developed. The process in 8 M HNO_3 creates conditions of increased stability of the tetravalent state making possible the synthesis of various Pr(IV) compounds. (DHM)

2247 RATE OF EXTRACTION IN SYSTEMS WITH TRIBUTYL PHOSPHATE. VI. Determination of the Coefficient of Mass Transfer on Mixing in a Centrifugal Field. Kuznetsov, G. I.; Pushlenkov, M. F.; Shchepetil'nikov, N. N.; Filyanin, A. T. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 582-588(1972).

Translated from Radiokhimiya; 14: No. 4, 567-574(1972).

The dependence of the coefficient of mass transport of uranyl nitrate in the system $UO_2(NO_3)_2$-2 M HNO_3-H_2O-1.1 M TBP in a mixture of saturated hydrocarbons on the rate of rotation of the centrifugal apparatus was determined. The data were compared with the results obtained in an apparatus with a fixed interface. The aggregate of data obtained: the strong dependence of the rate of extraction of uranium on the rate of rotation of the centrifugal apparatus, considering the change in the interfacial surface and the low value of the experimental activation energy, indicates that in this case the diffusion step of the extraction process is the rate determining step. The good agreement of the data obtained in a centrifugal apparatus and in a laboratory extractor with a fixed interface permits a model study of the process of extraction in a laboratory instrument and in certain cases a transfer of the results obtained to continuous action extractors with intensified mass exchange. (auth)

2248 CONTINUOUS CHROMATOGRAPHIC SEPARATION OF A MULTICOMPONENT MIXTURE OF SUBSTANCES IN LIQUID-LIQUID PARTITION CHROMATOGRAPHY. IV. Group Separation of the Alkaline Earth and Rare Earth Elements. Moskvin, L. N.; Tsaritsyna, L. G. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 603-606(1972).

Translated from Radiokhimiya; 14: No. 4, 588-592(1972).

The peculiarities of devices for continuous two-dimensional chromatography with a layer of sorbent welded to the walls bound-

ing it were discussed. A group separation of alkaline earth and light and heavy rare earth elements was conducted. (auth)

2249 SORPTION OF CESIUM, STRONTIUM, AND CALCIUM FROM SOLUTIONS OF TITANIUM(IV) PHOSPHATE. Dolmatov, Yu. D.; Bulavina, Z. N.; Dolmatova, M. Yu. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 543-546(1972).

Translated from Radiokhimiya; 14: No. 4, 526-530(1972).

A series of samples of titanium phosphate was synthesized from various initial solutions by precipitation with phosphoric acid. The sample of titanium phosphate produced from a concentrated sulfuric acid solution of titanium (IV) with an increased concentration of free acid, has pK = 2.1 at high distribution coefficients (at pH 7, $\varphi_{Sr} \simeq 3.1 \times 10^4$ and $\varphi_{Ca} \simeq 2.4 \times 10^4$). The ion exchange properties of samples of titanium phosphate were studied as a function of the conditions of their production (initial state of the solutions) by the methods of pH-metric titration and determination of the distribution coefficients of Cs^+, Sr^{2+}, and Ca^{2+} at pH of the equilibrium solutions 4 and 7. Some means of controlled synthesis of titanium phosphate and its use in ion exchange and radiobiological practice were demonstrated. (auth)

2250 SORPTION OF SCANDIUM BY ION EXCHANGE RESINS FROM AQUEOUS AND AQUEOUS–ACETONE SOLUTIONS OF TARTARIC, CITRIC, AND HYDROCHLORIC ACIDS. Brykina, G. D.; Isaeva, L. B.; Belyavskaya, T. A. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 532-535(1972).

Translated from Radiokhimiya; 14: No. 4, 515-519(1972).

Results of a study of the behavior of scandium in aqueous and aqueous–acetone solutions of organic acids on KU-2-H show that the sorption, which is 100% in hydrochloric acid solutions ([HCl] = 0.001) drops with the introduction and increasing concentration of organic acids, and the decrease in the sorption of scandium with other conditions equal is greater from solutions of tartaric acid than from citric acid. The introduction of acetone into the solution increases the sorption of scandium from aqueous solutions of tartaric and citric acids by anion exchange resin is approximately the same as with the cation exchange resin. (DHM)

2251 COPRECIPITATION OF FISSION PRODUCTS WITH MAGNESIUM HYDROXIDE. I. Coprecipitation of Cs, Sr, Y, Mo, Sb, Se, As, Nb, Zr, Ru, Zn, Cd, Ce. Novikov, A. I.; Ruzankin, V. I. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 521-527(1972).

Translated from Radiokhimiya; 14: No. 4, 505-511(1972).

The precipitation of magnesium hydroxide with increasing pH of the medium from pH = 9 up to 5 M KOH, with an initial 1 M solution of ammonium nitrate, and the precipitation of the carrier in the same solution in the presence of hydrogen peroxide and ammonium bicarbonate were studied. The dependence of the coprecipitation with magnesium hydroxide on the pH of the medium was studied for isotopes "without a carrier": ^{134}Cs, ^{89}Sr, ^{91}Y, ^{144}Ce, $^{95}Zr + {}^{95}Nb$, ^{95}Nb, $^{103,106}Ru$ (+ ^{106}Rh), ^{65}Zn, ^{109}Cd, and ^{125}Sb and small quantities of ^{115m}Cd, ^{99}Mo, ^{75}Se (IV,VI) and ^{76}As(V,III). Cs, Mo(IV), Se(IV) and Sr are not coprecipitated with Mg hydroxide in the entire range of pH studied. It was shown that the group concentration of yttrium, cerium, niobium, zirconium, and ruthenium by coprecipitation with magnesium hydroxide from an initial 1 M solution of ammonium nitrate is possible at pH > 11. In a solution of hydrogen peroxide and ammonium carbonate, the pH of their complete precipitation is increased to 12 and 13, respectively. The concentration of zinc is possible in the presence of hydrogen peroxide in the range of pH = 10 to 12, cadmium at pH > 13, and arsenate ions in the interval of pH = 11 to 12. It was established that in strongly alkaline medium (5 M KOH), there is a separation of cesium, molybdenum, selenium (VI,IV), arsenic (V,III), zinc, and strontium from yttrium, cerium, zirconium, niobium, ruthenium (rhodium), and cadmium by coprecipitation of the latter elements with magnesium hydroxide. (auth)

2252 COMPLEX FORMATION OF ACTINIUM. I. Determination of the Stability Constants of Ethylenediaminetetraacetate Complexes of Actinium and its Separation from Lanthanum in Solutions of EDTA by the Method of Electromigration. Makarova, T. P.; Sinitsyna, G. S.; Stepanov, A. V.; Shestakova, I. A.; Shestakov, B. I. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 555-557 (1972).

Translated from Radiokhimiya; 14: No. 4, 538-541(1972).

The composition and stability constants of complex compounds of actinium with EDTA were determined by an electromigration method. Conditions were found for the separation of actinium from certain rare earth elements (La, Ce) in ethylenediaminetetraacetate solutions by methods of paper electrophoresis and electrophoresis on quartz sand. (auth)

2253 SEPARATION OF RARE EARTH MIXTURES BY MULTISTAGE DISTRIBUTION WITH BIS(2-ETHYLHEXYL) PHOSPHATE. Busemann, J. (Technische Univ., Hanover). Z. Anorg. Allg. Chem.; 396: No. 2, 232-244(Feb 1973). (In German).

Mixtures of light and heavy lanthanides are distributed between an aqueous solution of their chlorides and an organic solution of bis(2-ethylhexyl) phosphate using a multistage cascade of mixer-settlers. The distribution of the rare earths in this system is based on an ion-exchange. By varying the equilibrium position in a suitable manner a practically complete reflux at both ends of the cascade is obtained. The pattern of the concentrations within the apparatus and the separating effects are discussed. The process partly yields very high separating effects. (auth)

2254 BEHAVIOR OF INORGANIC IONS IN PAPER CHROMATOGRAPHY WITH ALCOHOL–ACID SOLVENTS. Nascutiu, T. (Institut de Physique Atomique, Bucharest). Rev. Roum. Chim.; 18: No. 1, 161-174(Jan 1973). (In French).

The behavior of about 60 inorganic ions was studied in solvents of alcohols and hydrochloric acid 1 to 10N (1:1), of alcohols and nitric acid, or of alcohols and 40% HF–6N HCl (in different proportions), in order to establish the possibilities of separation. Data are presented to show that solvents consisting of alcohol and hydrochloric acid of different normalities and in different proportions make possible the separation of a large number of elements, including Cs, Sr, Sc, Y, La, Zr, Th, Nb, Mo, U, Tc, Ta, Te, Po, and the rare earths. The solvents studied were used for the separation of the products resulting from different nuclear reactions both for the identification and quantitative determination as well as for obtaining proof having a radiochemical purity adequate for the measurement of radioactive constants. (tr-auth)

2255 SEPARATION OF THULIUM AND YTTERBIUM IN ACIDIC CHLORIDE SOLUTIONS BY FRACTIONAL SOLVENT EXTRACTION. Thomas, N. E.; Smutz, M.; Burkhart, L. (Ames Lab., Iowa). Ind. Eng. Chem., Fundam.; 10: No. 3, 453-458 (Aug 1971). (IS-2321).

Equilibrium data were obtained for the systems $TmCl_3$–5 M HCl–H_2O–1 M bis(2-ethylhexyl) phosphate (HDEHP) in Amsco odorless mineral spirits and $YbCl_3$–$TmCl_3$–5 M HCl–H_2O–1 M HDEHP–Amsco. The separation factor for Yb with respect to Tm was found to be essentially constant with a value of 3.22. An empirical correlation was developed for predicting the total distribution coefficients for the binary lanthanide system $YbCl_3$–$TmCl_3$–5 M HCl–H_2O–1 M HDEHP–Amsco. A computer program using the distribution correlation and the experimental value of the separation factor was used to predict the operating conditions necessary for the separation of a 90% $YbCl_3$–10% $TmCl_3$–5 M HCl feed into a 98% Yb extract product at 90% Yb recovery. The predicted conditions were verified experimentally by simulated column runs in the laboratory. (auth)

2256 METHOD FOR THE CONCENTRATION OF HEAVY METAL CATIONS USING ION SELECTIVE MEMBRANES. Wu, J. S. H.; Baker, B. L. (to United States Atomic Energy Commission). U. S. Patent 3,718,583. 27 Feb 1973. Filed date 29 Nov 1971. 10p.

The concentration of heavy metal cations, such as uranyl or plutonium cations, from ionic solutions separated by an ion selective membrane, wherein the difference in chemical potentials of the various ion species provide the driving force to effect a transfer across the membrane, is enhanced by separating a portion of the extract solution being concentrated in heavy metal cation product and recirculating that portion along with the initial strip solution into contact with the membrane. The preferred ratio of the recirculating portion to the initial strip solution is between about 1 to 1 and 5 to 1. (auth)

2257 RARE EARTH REMOVAL FROM AMERICIUM OXIDE. Proctor, S. G. (to United States Atomic Energy Commission). U. S. Patent 3,723,594. 27 Mar 1973. Filed date 18 May 1972. 6p.

Americium oxide materials having rare earths as impurities may have these removed by oxidizing the americium to the hexavalent state, precipitating and removing rare earth values using hydrofluoric acid, reducing the americium to the trivalent state, thereafter precipitating and removing americium oxalate using oxalic acid, and calcining the americium oxalate to americium oxide. (auth)

2258 BINARY AND TERNARY ION-EXCHANGE EQUILIBRIA. Sodium–Cesium–Manganese–Dowex 50W-X8 and Cesium–Manganese–Strontium–Dowex 50W-X8 Systems. Bajpai, R. K.; Gupta, A. K.; Gopala Rao, M. (Indian Inst. of Tech., Kanpur). J. Phys. Chem.; 77: No. 10, 1288-1293(10 May 1973).

A single-particle radioactive tracer technique was employed for equilibrium measurements of two ternary systems, viz., Sr^{2+}–Mn^{2+}–Cs^+ and Mn^{2+}–Cs^+–Na^+, and the five-component binary systems with Dowex 50W-X8 resin. All the measure-

ments were made at a temperature of 23°C. Experimental binary equilibrium data were analyzed using a generalized phase equilibria theory. A simple correlation was proposed to predict resin phase activity coefficients of ions in a ternary system. Using these activity coefficients and equilibrium constants of the two binary pairs containing the most selective ion, resin-phase selectivities for ternary systems were successfully predicted. (auth)

2259 FOCUSING CHROMATOGRAPHY USING A DILUTE PRECIPITATION REAGENT. Separation of Several Alkaline Earth Ions using Potassium Fluoride. Furushima, K. (Kinki Univ., Higashiosaka, Japan); Shinagawa, M. Jap. Anal.; 22: No. 2, 196-200(Feb 1973). (In Japanese).

The focusing chromatography separation of radioactive alkaline earth and rare earth elements with potassium fluoride as a precipitation reagent was investigated. The sample solutions were 0.01 M hydrochloric acid containing a tracer amount of either ^{140}Ba (containing ^{140}La), ^{144}Ce (containing ^{90}Y) or ^{144}Ce (containing ^{144}Pr). Each of these nuclides was carrier free, and the activity of each solution was 1 μ Ci/ml. The separated radioactive bands on the paper chromatogram were located by autoradiography. According to the detected positions, the filter paper was cut into pieces and the species of the radionuclides were determined by γ-ray spectrometry and the measurements of the energies and the half-lives of β-rays. The method gave good results for focusing and separating ^{144}Ce, ^{140}Ba, ^{90}Sr from the daughter nuclides, ^{144}Pr, ^{140}La, or ^{90}Y, respectively. Moreover, this procedure was effective for the separation of alkaline earth group from rare earth group. The optimum separation was obtained by using 0.05 M hydrochloric acid in the positive cell, 0.05 M solution of potassium fluoride (buffered with sodium acetate) in the negative cell, the pH of which was 5.2 to 5.7, intensity of the electric field being 500 V/26 cm and migration time being 10 minutes. (DHM)

2260 USE OF N-CINNAMOYLPHENYLHYDROXYLAMINE IN ANALYTICAL CHEMISTRY. 8. Separation of Titanium and Zirconium from Beryllium and Uranium. Kulumbegashvili, V. A.; Ostroumov, E. A. (Inst. of Oceanology, Moscow). Zh. Anal. Khim.; 28: No. 1, 73-76(Jan 1973). (In Russian).

Beryllium and uranium are not precipitated with N-cinnamoylphenylhydroxylamine at the acidity of 1N in HCl and H_2SO_4 and higher. The precipitation of titanium and zirconium with the reagent in the presence of beryllium and uranium was studied. A method was developed for the separation and determination of titanium and zirconium in the presence of beryllium and uranium. One step precipitation is needed. (auth)

2261 ANION EXCHANGE SEPARATION OF RARE EARTHS IN METHANOL-NITRIC ACID MIXED SOLUTIONS. I. Study on the Distribution Coefficients and Column Elution Method. Chen, Y. M.; Liao, S. C. (National Taiwan Univ., Taipei). J. Chin. Chem. Soc. (Taiwan); 19: No. 3, 93-102(1972).

An anion exchange method for the mutual separation of rare earths was studied in methanol–nitric acid mixed solutions. For each rare earth element, the distribution coefficients in different concentrations of nitric acid and also in various compositions of methanol solution were studied with the batch equilibrium method. From these distribution coefficients, the elution of rare earths by gradient variation in the compositions of methanol was devised; that is, by keeping the nitric acid constant at 2 N and gradually diluting methanol from its original 80% by volume. Results were satisfactory for the mutual separation of the lighter rare earths, but only fair for the heavier earths. The secondary metal effect for this anion exchange was also studied in 80% by volume of methanol solution by keeping the total concentration of nitrate at 0.8 N. Distribution coefficients were larger than nitric acid with $LiNO_3$ but smaller in the case of NH_4NO_3 and $NaNO_3$. Despite these differences in distribution coefficients, no remarkable differences were observed for the separation factors of adjacent pairs. (auth)

2262 ANION EXCHANGE SEPARATION OF ELEMENTS THAT CAN BE EXTRACTED WITH TRIBUTYL PHOSPHATE. III. Separation and Determination of Gold. Koch, W.; Korkisch, J. (Univ., Vienna). Mikrochim. Acta; No. 1, 117-138(1973). (In German).

Methods are described for the exchange separation of gold from the metal ions that are usually well extractible with TBP, and that have been developed on the basis of the behavior of this element on the anion exchanger Dowex 1, X8 in the chloride form in the solvent system containing TBP. It was shown that the most favorable separating effects were created through the fact that gold, obviously as the result of the production of a stable well-solvated TBP complex, remains dissolved in the solvent phase and is not adsorbed on the anion exchanger, whereas the interfering elements are firmly held there. In particular, separations were accomplished between gold on one hand and Cu, Zn, Co, Hg, U, and the platinum metals on the other, all of which as a consequence of the formation of stable chlorocomplexes, are strongly adsorbed on the anion exchanger and because of the formation of less stable TBP complexes and hence are quantitatively separated from Cu(II), Co(II), Hg(II), UO_2(II), and Pd(II). In order to accomplish the separation from those elements, which like gold are not adsorbed on the ion exchanger, a reducing cellulose was prepared with which gold is specifically reducible to metal, and deposited in the fiber, and after destruction of the organic substance and solution in aqua regia it may be determined complexometrically. (auth)

2263 SEPARATION OF ANTIMONY FROM URANIUM USING ZIRCONIUM PHOSPHATE. Aly, H. F.; Marei, S.; Zakareia, N. (Atomic Energy Authority, Cairo). Mikrochim. Acta; No. 1, 1-7 (1973).

The distribution behavior of antimony and uranium between zirconium phosphate and hydrochloric acid solutions of different concentrations was determined. The effect of organic solvent addition to the aqueous phase on the distribution data was investigated. In all cases, the separation factors are evaluated and discussed. The best separation factor was achieved using 1 M HCl over all organic–aqueous solvent mixtures. On the basis of these findings, a procedure has been developed for the separation of antimony from uranium using a chromatographic column loaded with zirconium phosphate and 1 M HCl as eluant. (auth)

2264 PHOTOLYTIC SEPARATION OF URANIUM FROM BERYLLIUM, MAGNESIUM, AND ZINC. Naik, N. C.; Sahoo, B. (Utkal Univ., Bhubaneswar, India). J. Inst. Chem. (India); 44: No. 1, 26-27(1972).

Separation of uranium from beryllium, magnesium, and zinc was carried out by photolysis in sunlight. For this purpose, a mixture of uranyl sulfate with beryllium, magnesium, and zinc containing formic acid and alcohol was exposed to sunlight. Pure uranium was precipitated in the form of hydrated uranium oxysulfate leaving other cations in solution. (auth)

2265 RECENT TRENDS IN THE EXTRACTION OF SELENIUM AND TELLURIUM FROM ELECTROLYTIC COPPER SLIMES. Singh, N.; Mathur, S. B. NML (Nat. Met. Lab.) Tech. J. (Jamshedpur, India); 12: No. 4, 101-110(Nov 1970).

Selenium and tellurium occur either as elements or as selenides and tellurides respectively, in the Cu anode slime, and the principles of their recovery depend on the actual analysis. Besides conventional soda smelting, soda roasting, and acid roasting recovery treatments, recently developed methods such as caustic soda or ammonium sulfide leaching, acid or alkali pressure leaching, roasting and passing through soda, shaft furnace sintering, calcination and vacuum sublimation, and chlorination are briefly discussed. (43 references) (Metals Abstr.)

2266 SEPARATION OF ACTINIUM AND THORIUM BY SORPTION ON ION EXCHANGE RESINS FROM SULPHURIC ACID SOLUTIONS. Karalova, Z. K.; Rodionova, L. M.; Pyzhova, Z. I. Zh. Anal. Khim.; 28: No. 2, 290-293(Feb 1973). (In Russian).

The sorption of actinium and thorium on the AV-17 anion exchanger and the KU-2 cation exchanger from aqueous and aqueous–ethanol solutions was studied depending on H_2SO_4 concentration. Conditions were found for the separation of actinium from thorium. (auth)

2267 SORPTION OF LANTHANUM(III), COBALT(II), AND IODIDE IONS AT TRACE CONCENTRATIONS ON FERRIC HYDROXIDE. Sipalo-Zuljevic, J.; Wolf, R. H. H. (Rudjer Boskovic Inst., Zagreb). Mikrochim. Acta; No. 2, 315-320 (1973).

The sorption of lanthanum(III), cobalt(II) and iodide traces was studied as to dependence on the solid–liquid contact time, pH value, and the properties of the carrier (internally or externally formed). The ferric hydroxide carrier was prepared by mixing aqueous ferric chloride and ammonia solutions. The results are discussed in regard to colloidal properties of the ferric hydroxide and mechanisms of sorption. (auth)

2268 ANION EXCHANGE SEPARATION OF THE ELEMENTS EXTRACTABLE WITH TRIBUTYL PHOSPHATE. IV. Separation of Uranium from Some Elements. Koch, W.; Korkisch, J. (Univ., Vienna). Mikrochim. Acta; No. 2, 225-244(1973). (In German).

Methods are described for the separation of elements that can be extracted with TBP using strongly basic anion exchanger Dowex 1, X8 in its chloride form and an aqueous organic mixture of 30 vol % TBP, 60 vol % methyl glycol, and 10 vol % of 12 M hydrochloric acid. In particular, separations of uranium from elements that are extracted well by TBP from hydrochloric acid solutions and from those that are only poorly extracted by TBP were studied. The differing adsorption behaviors may be ex-

plained through the resulting KIALE effect. The behavior of the elements in the mixture containing TBP was compared with that in pure aqueous hydrochloric acid mixtures and the difference was explained through the above effect. Separation procedures are given for uranium from In(III), Tl(III), Th(IV), Pb(II), Mn(II), Zr(IV), As(III,V), Sn(II,IV), Mo(VI), V(IV,V), and Sb(V). In the separation from bismuth it was possible to establish the existence of a competition of the two differing strongly adsorbed elements for the functional groups of the resin, which leads to the fact that only a part of the uranium is adsorbed. Similarly there was found a reciprocal action between uranium and manganese, the consequence of which was that the manganese is preferentially eluted. In addition, a procedure is described for the separation of the elements selenium and tellurium and also for various spectrophotometric methods for the quantitative determination of the studied metal ions in mixtures containing TBP. (auth)

2269 ANIONIC EXCHANGE SEPARATIONS OF THE ELEMENTS EXTRACTABLE WITH TRIBUTYL PHOSPHATE. V. Separation Possibilities in TBP–HCl- or TBP–methyl glycol–HCl Containing Solvent Systems. Koch, W.; Korkisch, J. (Univ., Vienna). Mikrochim. Acta; No. 2, 245-262(1973). (In German).

A systematic investigation was made of several characteristic elements extractable with TBP and the adsorption of these elements was determined from pure TBP (saturated with 6 M HCl) and determined from various different mixtures of TBP, methyl glycol, and 12 M HCl on the strongly basic anion exchanger Dowex 1, X8 in its chloride form. The adsorption of all the elements investigated, including UO_2(II), Mo(VI), Te(IV), and Zr(IV), from pure TBP is slight; usable separation effects could not be observed. However, in the presence of methyl glycol, there occurs an extensive differentiation of the exchange behavior, so that it is possible to differentiate between the two groups of which the one includes the element that is adsorbed to a greater or lesser extent from most mixtures containing TBP, whereby a very definite decrease may be observed in the Kd values with increasing TBP and HCl concentration. In the other group there is little or no adsorption at all of the metal ions and this may be observed by a slight alteration of the Kd values with alteration of the TBP or HCl concentration. A mixture of 30 vol % TBP, 60 vol % methyl glycol and 10 vol % of 12 M HCl is the most suitable for separations of the elements extractable with TBP (especially uranium from various accompanying elements) by anion exchange. (auth)

2270 ANIONIC EXCHANGE SEPARATIONS OF THE ELEMENTS EXTRACTABLE WITH TRIBUTYL PHOSPHATE. VI. Influence of Various Resin Anion Forms on the Extractability of Elements in TBP-Containing Solvent Mixtures. Koch, W.; Korkisch, J. (Univ., Vienna). Mikrochim. Acta; No. 2, 263-272(1973). (In German).

The separation of various elements extractable with TBP from solutions containing nitric acid, especially uranium on various forms of the strongly basic anionic exchanger Dowex 1, X8 was studied. Included in the metal ions studied are UO_2(II), Th(IV), Zr(IV), Ce(IV), Sc(III), Ru(III) and (IV), and Mo(VI). The fluoride, chloride, bromide, nitrate, sulfate, and acetate forms of the resin were employed for this purpose. The chloride resin is especially suitable for the separation of uranium, whereas other resin anionic forms may not be employed for the separations in solvent mixtures containing TBP. (auth)

2271 SULPHONATED AZO-DYES AS EXTRACTIVE METALLOCHROMIC REAGENTS. Woodward, C.; Freiser, H. (Univ. of Arizona, Tucson). Talanta; 20: No. 4, 417-420(Apr 1973).

A survey has been made of analytically useful extractable ion-pair complexes that are formed by the use of a series of metallochromic indicator-metal complexes in conjunction with quaternary ammonium ions. The reagents were O, O′-dihydroxyazo dyes and azo-oxines. Mo, U and Zr were among the metal ions tested. (auth)

2272 ION-EXCHANGE PROPERTIES OF HYDRATED PHOSPHATES OF NIOBIUM(V). Sukharev, Yu. I.; Egorov, Yu. V.; Pustovalov, N. N. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 10, 2321-2324(Oct 1972).

Translated from Zh. Prikl. Khim.; 45: No. 10, 2214-2217(Oct 1972).

Study of the selective-sorption characteristics of a new inorganic ion exchanger (hydrated niobium phosphate) under static and dynamic material demonstrated the high selectivity of the material modified by cation application for trivalent elements (cerium). The reduced diffusion coefficients of Ce(III) in HNP specimens were determined, and the favorable influence of cation application on the kinetics of sorptive extraction of ions was noted. A linear nature of the dependence of the basic ion-exchange and kinetic characteristics on the composition of HNP was established. (auth)

Inorganic, Organic, and Physical Chemistry

Refer also to abstracts 2632 and 2633.

Chemical and Physicochemical Properties

Refer also to abstract 2147.

2273 (INR-1430) PHYSICO-CHEMICAL PROPERTIES OF THE LANTHANIDE COMPLEXES WITH THENOYLTRIFLUOROACETONE. III. Infra-Red Spectra of the Lanthanide Complexes with TTA in the Region from 1700 to 400 cm^{-1}. Lis, S. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

The ir spectra of the $Ln(TTA)_3 \cdot nH_2O$ complexes and the dehydrated complexes of Nd, Gd, and Lu with TTA as well as the $Al(TTA)_3$ and $Fe(TTA)_3$ complexes were studied in the range 1700 to 400 cm^{-1}. All spectra of the investigated complexes in the range 1700 to 700 cm^{-1} are similar. The significant differences between Ln complexes and those of Al, Fe occur in the range 700 to 400 cm^{-1}. It was found that the wave number of the band appearing in the Ln complexes in the vicinity of 490 cm^{-1} increases monotonically with the atomic number. The behavior of the ν_2 and rocking bands of hydrating water molecules was discussed. The 1600 to 1500 cm^{-1} range was analyzed in detail and also the majority of the absorption bands in the remaining part of the spectrum were assigned. (auth)

2274 (JUL-915-RW) CONTRIBUTION TO IDENTIFY PYROLYSIS BY-PRODUCTS IN SOOT OF A FLUIDIZED BED AND IN PYROCARBON. Wolfrum, E.; Rottmann, J.; Bueker, L.; Nickel, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Jan 1973. 67p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

In the frame of developing improved fuel particles, both the pyrocarbon separated in fluidized beds and the resulting soot were studied as to their pyrolysis by-products. The separation mechanism of pyrocarbon on fuel kernels during the thermal decomposition of low hydrocarbons was studied. The extraction of pyrolysis products of acetylene and propylene was performed using various methods. The extracts were separated gas chromatographically and mass spectrometrically; the single components were partially identified. Twenty-one polycyclic and aromatic hydrocarbons were clearly identified in soot. In addition pyrocarbon contains still higher molecular polycycles. (auth)

2275 THERMAL DECOMPOSITION OF URANYL ACETATE. Yanachkova, I. M.; Staevsky, M. (Higher Inst. for Electrical and Mechanical Engineering, Sofia). J. Mater. Sci.; 8: No. 4, 606-610(Apr 1973).

By means of thermogravimetric, differential thermal analysis, x-ray, and infrared analysis the intermediate and final products of the decomposition are identified. After dehydration uranyl acetate decomposes to UO_2 which is partially oxidized to UO_3. The final product, U_3O_8, is obtained from the interaction of UO_2 with UO_3 in solid state. (auth)

2276 CHARACTER OF THE REACTIONS OF CARBIDES OF TRANSITION METALS OF GROUPS IV-VI WITH FERRIC OXIDE. Klimak, Z. A.; Kotlyar, E. E.; Serebryakova, T. I.; Yukhimenko, E. V. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1404-1408(Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1600-1605(Sep 1972).

It is shown that the onset temperature of the reaction of ferric oxide with carbides of Ti, Zr, Hf, Nb, Mo, and W decreases in the sequence M(IV)C–M(V)C–M(VI)C. At 1000°C, tungsten carbide forms a complex carbide Fe_3W_3C when it reacts with ferric oxide. (auth)

2277 METHOD OF PARTIAL CRYSTALLIZATION IN DETERMINING THE HOMOGENEOUS DISTRIBUTION COEFFICIENT IN COPRECIPITATING SYSTEMS. Purkayastha, B. C.; Das, N. (Saha Inst. of Nuclear Physics, Calcutta). J. Radioanal. Chem.; 12: No. 2, 461-467(Dec 1972).

The method of determining the homogeneous distribution coefficient by the partial crystallization procedure was examined. It was found that in chemically very similar systems, such as $FeSO_4 \cdot 7H_2O$ as host and ^{60}Co as guest, the partial crystallization technique gives very reliable data. However, in the case of $CoSO_4 \cdot 7H_2O$ as host and copper traces as guest, the distribution coef-

ficient found by the partial crystallization procedure is much lower than that obtained by the traditional method of complete equilibration. In this system the distribution coefficient increases as the period of partial crystallization is lengthened. The probable explanation of this particular behavior is discussed. (auth)

2278 RELATION BETWEEN THE STRUCTURE AND EXTRACTING POWER OF HIGHER TERTIARY AMINES. I. The Extraction of Nitric Acid. Shvedov, V. P.; Kopyrin, A. A.; Titov, V. S. (Leningrad Inst. of Tech.). J. Radioanal. Chem.; 12: No. 2, 421-430(Dec 1972).

The effects of the composition and structure of higher tertiary amines on their efficiency in extracting nitric acid were examined. The ionization constants of the amines in methanol were determined by potentiometric titration. The extraction constants for nitric acid were determined at constant ionic strength in the aqueous phase ($\mu = 1$). The dependence of these constants upon the concentrations and the degree of association of the amine salts in the organic phase was examined. For the cases in which the role of steric factors is negligible it was found that at low amine salt concentrations in the organic phase there are quantitative regularities between the ionization constants of the amines in methanol, their extraction constants for nitric acid, and the inductive effects of the substituents on the nitrogen atom. (auth)

2279 CALCULATION OF THE VIBRATIONS OF THE COMPLEX ION $[UO_2(NO_3)_3]^-$ IN RUBIDIUM URANYL NITRATE. Budai, L. I.; Kovrikov, A. B.; Komyak, A. I. Zh. Prikl. Spektrosk.; 18: No. 2, 293-299(Feb 1973). (In Russian).

The matrix force constants were determined for the complex ion $[UO_2(NO_3)_3]^-$ by the method of successive matching of experimental and computed frequencies. The frequencies and the forms of the normal vibrations were calculated. The difference between experimental and calculated frequencies lay within the margin of experimental error. (tr-auth)

2280 USE OF LIQUID EUTECTIC MIXTURES OF AROMATIC AMINES FOR HARDENING OF EPOXIDE COATINGS WITH HIGH RADIATION RESISTANCE. Sidyakin, P. V.; Egorov, B. N.; Adamchikova, L. M.; Karpov, V. L. Lakokrasoch. Mater. Ikh Primen.; No. 4, 42-46(1972). (In Russian).

A plastic material was developed which could be readily prepared without special chemical equipment, would set up in the cold, and yield coatings resistant to heat (150°C) and radiation-resistant (up to 5×10^9 Rad), and stable toward the action of concentrated HCl and HNO_3. The product ES-K-1 was selected as the hardener, the basic component of which was polymethylenephenyleneamine, a polycondensate of diaminediphenylmethane and ethylene glycol. The application of the liquid eutectic mixture of aromatic amines for hardening epoxide coatings was demonstrated. The formula and application of lacquer and enamel coatings by cold hardening was developed and the properties of the product were determined. (tr-auth)

2281 THERMODYNAMIC CHARACTERISTICS OF REDUCTION OF TUNGSTEN AND MOLYBDENUM OXIDES. Uvarova, I. V.; Skorokhod, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 34-38(1973). (In Russian).

The thermodynamic processes of reduction of MoO_3 and WO_3 by H_2 to MoO_2 and WO_2, and thence to the metallic state, were investigated over a range of temperature up to 1100°C. (KSW)

2282 KINETICS OF NITRIDING OF NIOBIUM. Levinskii, Yu. V.; Kiparisov, S. S.; Strogonov, Yu. D. Izv. Akad. Nauk SSSR, Metal.; No. 1, 70-73(1973). (In Russian).

The nitriding rate of Nb was studied between 1405 and 2035°C and the diffusion coefficient of nitrogen in NbN was calculated. Two stages were evident in the nitriding of Nb which were associated with a phase transition of a higher nitride of Nb. (KSW)

2283 RELATIONSHIP BETWEEN LATENT HEAT OF FUSION AND HEAT CONTENT OF ELEMENTS AT THE MELTING POINT. Solov'ev, V. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 103-107(1973). (In Russian).

An analysis of available literature data was made relative to heat contents and heats of fusion at the respective melting points for 70 elements. The ratio of $H/\Delta H_f$ is 3; deviations from this value for certain elements (As, Bi, A, Ga, etc.) were associated with clustering of the atoms. (KSW)

2284 REACTIONS OF HYDROCARBONS WITH HIGH-MELTING METALS. Hoerz, G.; Lindenmaier, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Met. Ital.; 64: No. 12, 542-546(Dec 1972). (In Italian).

Niobium and tantalum react with methane or acetylene at high temperatures (1500 to 2300°C) and low methane partial pressures (10^{-3} to 10^{-1} torr) or acetylene pressures (2×10^{-6} to 1×10^{-4} torr) to form gaseous hydrogen and metal-carbon solid solutions. The dissolution of carbon in niobium and tantalum causes large changes in the electrical resistivity of about 4.3 to 3.5 $\mu\Omega \cdot$ cm/at. % C at temperatures between 1500 to 2200°C. Only small amounts of the carbon dissolved at high temperatures in niobium and tantalum can be held in solid solution during quenching to room temperature. These amounts are about 0.1 at. % for niobium and 0.3 at. % for tantalum. At constant hydrocarbon partial pressure, the rate of the reactions of niobium and tantalum with methane is several orders of magnitude smaller than the rate of the reactions with acetylene. The reaction coefficients are about 10^{-4} to 10^{-3} for the carburization in methane and 0.5 to 0.9 for the carburization in acetylene. The carbon solubility limit in niobium and tantalum increases markedly with increasing temperature, reaching values of 2 at. % C at 2000°C. (9 figures, 3 tables, 29 references) (auth)

Isotope Effects

Refer also to abstract 2413.

2285 ACIDIC BEHAVIOR OF CHLOROFORM. Margolin, Z.; Long, F. A. (Cornell Univ., Ithaca, N. Y.). J. Amer. Chem. Soc.; 95: No. 9, 2757-2762(2 May 1973).

The detritiation of chloroform in aqueous buffer solutions involves only hydroxide ion; general base catalysis is not observable. No reaction with water is observable at either 25 or 50°C. The rate coefficient for the hydroxide ion reaction is 0.165 M^{-1} sec^{-1} at 25°C, implying that the pK of chloroform is about 24. The primary hydrogen isotope effect for the proton removal process, determined by a new accurate method, is $k^H/k^D = 1.42$ at 25°C. The entropy of activation for the aqueous detritiation by hydroxide is strongly positive; ΔS^* at 25° is +15 eu, about 25 eu above normal for k values in M^{-1} sec^{-1} units. This value drops sharply as DMSO is added to the reaction system implying that desolvation of hydroxide ion is a major contributor to the positive entropy. The Brønsted β for the hydroxide ion reaction, as determined in DMSO-H_2O solvent mixtures using the Bell and Cox procedure, is 0.98. These several data strongly suggest that the proton removal reaction of chloroform is fully normal in the Eigen sense, even for reaction with hydroxide ion. This result is in considerable contrast to most other carbon acids, including the otherwise normal cyanocarbons, in that hydroxide reaction is usually anomalously slow and Brønsted coefficients often differ considerably from the limiting values of zero and unity. (auth)

2286 MICROWAVE SPECTRUM, SUBSTITUTIONAL STRUCTURE, AND STARK AND ZEEMAN EFFECTS IN CYCLOPROPENONE. Benson, R. C.; Flygare, W. H.; Oda, M.; Breslow, R. (Univ. of Illinois, Urbana). J. Amer. Chem. Soc.; 95: No. 9, 2772-2777(2 May 1973).

The microwave spectra of the normal and four other isotopic species of cyclopropenone were assigned leading to a complete substitutional structure. The structural parameters are $d_{C=O} = 1.212 \pm 0.002$, $d_{C-C} = 1.412 \pm 0.003$, $d_{C=C} = 1.302 \pm 0.003$, $d_{C-H} = 1.097 \pm 0.003$ in units of 10^{-8} cm and the angles are $\angle HC_2C_3 = 144°55' \pm 20'$ and $\angle C_2C_3C_1 = 62°33' \pm 20'$. The molecular Stark effect has been observed giving an electric dipole moment of $|\mu| = (4.39 \pm 0.06) \times 10^{-18}$ esu cm. The molecular Zeeman effect was observed giving the molecular g values of $g_{aa} = -0.2900 \pm 0.0013$, $g_{bb} = -0.0963 \pm 0.0004$, and $g_{cc} = -0.0121 \pm 0.0004$ and the magnetic susceptibility anisotropies of $2\chi_{aa} - \chi_{bb} - \chi_{cc} = 13.6 \pm 1.1$ and $2\chi_{bb} - \chi_{aa} - \chi_{cc} = 22.0 \pm 0.8$ in units of 10^{-6} erg/(G^2 mol). The a axis is the electric dipole axis and the b axis is also in the molecular plane. The corresponding molecular electric quadrupole moments are $Q_{aa} = -3.0 \pm 0.9$, $Q_{bb} = 4.0 \pm 0.7$, and $Q_{cc} = -1.0 \pm 1.3$ in units of 10^{-26} esu cm^2. The molecular structure and electronic structure of cyclopropenone are discussed and compared with those of similar molecules. (auth)

2287 MICROWAVE SPECTRUM AND CONFORMATION OF FORMIMIDE. Steinmetz, W. E. (Harvard Univ., Cambridge, Ma.). J. Amer. Chem. Soc.; 95: No. 9, 2777-2782(2 May 1973).

The microwave spectrum of formimide and N-deuterioformimide was investigated. Vibrational satellite structure and rotational constants strongly support an asymmetric cis-trans planar structure in the gas phase. An approximate treatment of the observed quadrupole coupling constants gives a C-N double bond character of 66%. A reinterpretation of the ir spectrum of molten formimide shows that the cis-trans conformer is also preferred in the liquid phase. A cis-trans conformation is consistent with a bond dipole model and with the structures of similar compounds. (auth)

2288 POSITION-DEPENDENT DEUTERIUM EFFECTS ON RADIATIONLESS TRANSITIONS IN ANTHRACENE. Henry, B. R.; Charlton, J. L. (Univ. of Manitoba, Winnipeg). J. Amer. Chem. Soc.; 95: No. 9, 2782-2785(2 May 1973).

The triplet lifetimes of several specifically deuterated anthracenes are measured in glassy solution at 77°K by monitoring the

decay of triplet–triplet absorption after flash excitation. The derivatives studied comprise the 9,10-d_2, 1,4-d_2, 2,3-d_2, 1,4,5,8-d_4, 2,3,6,7-d_4, 1,2,3,4-d_4, and d_{10} compounds. Their triplet lifetimes show a significant dependence on the position of substitution. This dependence is interpreted theoretically, and the ratio of triplet deactivation rates for isomers containing the same number of deuterium substituents is calculated and compared to the experimental lifetime ratios. It is pointed out how this comparison might be used to further elucidate the theoretical interpretation of radiationless transitions. (auth)

2289 SOLVENT ISOTOPE EFFECTS AND THE MECHANISM OF CHYMOTRYPSIN ACTION. Kresge, A. J. (Illinois Inst. of Tech., Chicago). J. Amer. Chem. Soc.; 95: No. 9, 3065-3067 (2 May 1973).

In previous work [Pollock, Hogg, and Schowen, J. Am. Chem. Soc., 95, 968 (1973)] on the solvent isotope effects on the deacetylation of acetyl-α-chymotrypsin it was assumed that a linear relationship between isotope effect and solvent deuterium content can only indicate a one-proton transfer mechanism. In an effort to show that linear behavior does not exclude a multiple-proton transfer model, calculations of solvent isotope effects for some 2-proton transfer systems are tabulated. This data show that a limitless number of linear, multiple-proton transfer models duplicating the chymotrypsin data can be constructed. (DHM)

2290 MECHANISM OF THE FERRIC ION CATALYZED DECOMPOSITION OF HYDROGEN PEROXIDE. Effect of Organic Substrates. Walling, C.; Goosen, A. (Univ. of Utah, Salt Lake City). J. Amer. Chem. Soc.; 95: No. 9, 2987-2991(2 May 1973).

The retardation of the Fe^{3+} catalyzed decomposition of H_2O_2 in $HClO_4$ solution by a number of organic substrates was examined. Results with acetone, acetic acid, and tert-butyl alcohol are consistent with the redox chain mechanism of Barb, Baxendale, George, and Hargrave on the assumption that the substrates trap hydroxyl radicals which otherwise react with H_2O_2. Data show the predicted form and yield ratios of rate constants in fair agreement with those derived from radiation chemistry and $Fe^{2+}-H_2O_2$ experiments. The treatment also predicts the observed dependence on $[H^+]$, effect of Cu^{2+}, and primary isotope effect with CD_3COCD_3, and indicated kinetic chains of 30, much shorter than those estimated by Barb, et al. (auth)

2291 ACID-CATALYZED AND BASE-CATALYZED HYDRATION OF β OXY-α,β-UNSATURATED KETONES. Fedor, L. R.; De, N. C.; Gurwara, S. K. (State Univ. of New York, Buffalo). J. Amer. Chem. Soc.; 95: No. 9, 2905-2911(2 May 1973).

Hydrations of 20 β-oxy-α,β-unsaturated ketones to β-keto aldehydes or β-diketones in acidic solution are catalyzed only by hydronium ions; general acid catalysis is not observed. This result coupled with that of insensitivity of rates of hydration to structural changes in the ketones is offered in support of a mechanism involving equilibrium protonation of the carbonyl oxygen atom followed by rate-determining addition of water to the β carbon of the cation; decomposition of the hemiacetal or β elimination of the oxy group gives products. Hydrations of 4-(para-substituted phenoxy)-3-buten-2-ones to phenols and 3-ketobutanal in alkaline solution are postulated to occur via rate-determining Michael addition of hydroxide ion to the β-carbon atom followed by ketonization of the enolate anion concerted with elimination of para-substituted phenoxides. Acid catalyzed hydrations of β-oxy-α,β-unsaturated ketones to β-keto aldeheyds are characterized by a deuterium solvent isotope effect, $K_D/K_H \sim 2.5$. (DHM)

2292 POLYFUNCTIONAL CATALYSIS. IV. Oxy Acid Catalysis of the Mutarotation of Tetramethyl-D-Glucose in Benzene. Rony, R. R.; Neff, R. O. (Monsanto Co., St. Louis). J. Amer. Chem. Soc.; 95: No. 9, 2896-2905(2 May 1973).

An experimental study of the mutarotation of 2,3,4,6-tetramethyl-D-glucose (TMG) in benzene was performed. The rate law for all of the catalysts studied is rate = $(k_1 + k_1')[\text{catalyst}]\{[TMG] - [TMG]_e\}$, where $[TMG]_e$ is the concentration of α-tetramethylglucose at equilibrium. The activation parameters, relative to the catalyst–substrate complex, are: (1) diphenyl phosphate, $\Delta H^{\ddagger}$ = 14.1 kcal/mol and $\Delta S^{\ddagger} = -10.8$ gibbs/mol at a standard state of 1 mol/l. at 25°; (2) benzenephosphinic acid, $\Delta H^{\ddagger}$ = 14.1 kcal/mol and $\Delta S^{\ddagger} = -8.8$ gibbs/mol; (3) trichloroacetic acid, $\Delta H^{\ddagger}$ = 14.1 kcal/mol and $\Delta S^{\ddagger} = -15.4$ gibbs/mol; (4) benzoic acid, $\Delta H^{\ddagger}$ = 13.2 kcal/mol and $\Delta S^{\ddagger} = -21.4$ gibbs/mol; (5) 2-pyridone, $\Delta H^{\ddagger}$ = 13.2 kcal/mol and $\Delta S^{\ddagger} = -22.7$ gibbs/mol; (6) pyrazole, $\Delta H^{\ddagger}$ = 13.2 kcal/mol and $\Delta S^{\ddagger} = -30.2$ gibbs/mol; (7) 2-aminopyridine, $\Delta H^{\ddagger}$ = 13.2 kcal/mol and $\Delta S^{\ddagger} = -24.6$ gibbs/mol; and (8) picric acid, $\Delta H^{\ddagger}$ = 12.7 kcal/mol and $\Delta S^{\ddagger} = -28.4$ gibbs/mol. Brønsted plots of catalytic activity vs. pK_{H_2O} suggest that strong oxy acids as tautomeric catalysts for the mutarotation of tetramethylglucose in nonpolar solvents. Data are tabulated for catalysis of the mutarotation of glucose by 2-pyridene in H_2O and D_2O. (auth)

2293 CARBONIUM ION REARRANGEMENTS IN THE DELTACYCLANE RING SYSTEM. III. Solvolytic Reactions of C-5 Substituted Exo- and Endo-8-Deltacyclyl Brosylates. Freeman, P. K.; Stevenson, B. K. (Oregon State Univ., Corvallis). J. Amer. Chem. Soc.; 95: No. 9, 2890-2896(2 May 1973).

The preparation of a series of C-5 substituted exo- and endo-8-deltacyclyl brosylates, exo- and endo-8-brosyloxydeltacyclan-5-one, exo- and endo-8-brosyloxydeltacyclan-5-one ethylene glycol ketal and exo- and endo-8-brosyloxydeltacyclan-5-one ethanedithiol ketal is described. The rates of acetolysis of these substrates, relative to the rates of the parent brosylates, exo-8-deltacyclyl brosylate (exo-1-OBs) and endo-8-deltacyclyl brosylate (endo-1-OBs) (k_X/k_H), are used to determine the sensitivity to C-5 substitution ($\rho_{exo} = -2.68$, $\rho_{endo} = -1.63$). The acetolyses of exo- and endo-8-brosyloxydeltacyclan-5-one are nonstereospecific generating ratios of exo:endo unrearranged acetate of 87:13 and 89:11, respectively. A study of secondary β-deuterium isotope effects on the solvolysis of labeled exo- and endo-1-OBs revealed a large isotope effect for the endo brosylate, $K_H/K_D = 1.26 \pm 0.02$, and a reduced isotope effect for the exo brosylate $K_H/K_D = 1.14 \pm 0.02$. (auth)

2294 SYNTHESIS AND FAR-INFRARED SPECTRA OF FERRIC OCTAETHYLPORPHINE COMPLEXES. Ogoshi, H.; Watanabe, E.; Yoshida, Z.; Kincaid, J.; Nakamoto, K. (Kyoto Univ.). J. Amer. Chem. Soc.; 95: No. 9, 2845-2849(2 May 1973).

Ferric octaethylporphine (OEP) complexes of the types Fe(OEP)X ($X^- = CH_3COO^-$, F^-, Cl^-, Br^-, I^-, N_3^-, and NCS^-) and $[Fe(OEP)L_2](ClO_4)$ (L = γ-picoline, imidazole and benzimidazole) were prepared, and their infrared spectra were measured in the 4000 to 100-cm^{-1} region. The Fe–N(OEP), Fe–X, and Fe–L stretching bands were assigned based on metal isotope substitution ($^{54}Fe/^{56}Fe$). (auth)

2295 THERMAL ISOTOPIC EFFECTS IN THE MASS-SPECTRA OF C_2H_4 AND C_2D_4. Komov, V. N.; Tikhomirov, M. V. (Physical-Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 356-362(Mar 1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 403-407(1972).

The dependence of the mass-spectra of C_2H_4 and C_2D_4 on the temperature of the molecules (180 to 800°C) was investigated. It is shown that the relative content of molecular ions in the mass-spectrum of deuteroethylene decreases with rising temperature to a greater extent than for ethylene. Thermal isotopic effects were also observed for some fragment ions. The thermal isotopic effects are explained by differences in the mean thermal vibrational energies of C_2H_4 and C_2D_4, due to the different vibrational frequencies of these molecules at the same temperatures. (auth)

2296 PREPARATION OF ^1C TRITIATED OR DEUTERATED ACROLEIN. Golfier, M.; Prange, T. (Ecole Polytechnique, Paris). J. Label. Compounds; 8: No. 4, 623-635(1972). (In French).

The synthesis of ^1C tritiated or deuterated acrolein is described. The oxidation of allylic alcohol with the silver carbonate on Celite reagent shows an important isotopic effect. One can take advantage of this effect for a simple preparation of tritiated aldehydes. The NMR spectrum of deuterated acrolein is analysed and calculated. (auth)

2297 KINETICS OF HYDROGEN–DEUTERIUM EXCHANGE REACTIONS OF MODEL COMPOUNDS IN CARBON TETRACHLORIDE. Moran, M. J. Cincinnati; Univ. of Cincinnati (1972). 96p. University Microfilms Order No. 73-7173.

Thesis (Ph. D.).

The hydrogen–deuterium exchange reactions of five model compounds were studied in the nonpolar solvent carbon tetrachloride using infrared spectrophotometric techniques. Benzyl alcohol, N-methylaniline, N-methylacetamide, γ-butyrolactam, and o-nitrophenol were reacted with deuterium oxide in carbon tetrachloride. The reactions of benzyl alcohol and N-methylaniline with the deuterium oxide in carbon tetrachloride were too fast to measure using our infrared techniques. The reaction of N-methylacetamide was slower than the exchange reactions for the benzyl alcohol and N-methylaniline. The reaction of N-methylacetamide followed second order kinetics. The measured rate constant was 0.55 M^{-1} min^{-1} at 30°C. The energy of activation for this reaction was 21.6 kcal/mole. The exchange reaction of γ-butyrolactam, which has a cis conformation, with deuterium oxide in carbon tetrachloride was a slow reaction, but was faster than the exchange reaction of N-methylacetamide. γ-butyrolactam has a free N–H and two hydrogen bonded hydrogens in a cyclic dimer. Exchange rates were measured for both monomer and dimer. A second order rate constant of 30.0 M^{-1} min^{-1} for both the monomer and dimer was measured. The energy of activation was determined to be 13.1 kcal/mole. The exchange reaction of o-nitrophenol, which exists primarily in an intramolecular hydrogen bonded state, with deuterium oxide in

carbon tetrachloride gave a second order rate constant of 35.1 M^{-1} min^{-1}. This rate constant for a hydrogen in a hydrogen bonded form is 100 times as large as the rate constant for the free N–H of N-methylacetamide. N-methylacetamide and γ-butyrolactam were reacted with the deuterated compounds, phenol, phenylacetic acid, benzyl alcohol, N-methylaniline, o-nitrophenol, and p-nitrophenol in carbon tetrachloride. The second order rate constants for the exchange reactions of N-methylacetamide with these deuterated compounds were larger than the reaction of N-methylacetamide with deuterium in carbon tetrachloride. The exchange rate constants of the deuterated phenol and deuterated phenylacetic acid with N-methylacetamide in carbon tetrachloride were 200 times larger than the rate constant of N-methylacetamide with deuterium oxide in carbon tetrachloride. The results of the exchange reactions and the energies of activation are discussed with regard to a mechanism by which the exchange of the labile hydrogens in proteins occur. It is argued that being in a hydrogen bonded state favors exchange. It is argued that a basic group trans to an exchanging group, X–H, retards the exchange rate by competing for the deuterium oxide. (Diss. Abstr. Int., B)

2298 EFFECT OF ISOTOPIC SUBSTITUTION ON THERMODYNAMIC STABILITY. Semenchenko, V. K.; Nedostup, N. A.; Baskakov, V. Ya. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 10, 1439-1441(Oct 1972).

Translated from Zh. Fiz. Khim.; 46: No. 10, 2507-2510(Oct 1972).

The thermal, mechanical, and overall thermodynamic stability of several deuterated organic compounds and their ordinary analogues was investigated. The thermodynamic stability is found to diminish on deuteration. Another generalisation is that the critical temperature is lower than for the normal compound. (auth)

2299 ISOTOPE EFFECT IN THE INFRARED SPECTRUM OF PERFLUOROTOLUENE. Petrov, A. K.; Petrova, T. D.; Platonov, V. E. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 1, 148-149(Jan 1973). (In Russian).

The infrared spectra of isotopic perfluorotoluenes $C_6F_5C^{12}F_3$ and $C_6F_5C^{13}F_3$ were measured. The stretching vibration of the CF_3-group was assigned. (auth)

2300 MECHANISM OF THE CLEAVAGE OF DIETHYL ETHER WITH ALKYLLITHIUM COMPOUNDS: DISTINGUISHED DECOMPOSITION MECHANISMS OF α- AND β-DEUTERATED ETHYL ETHER. Maercher, A.; Demuth, W. (Univ., Erlangen, Ger.). Angew. Chem.; 85: No. 2, 90-92(1973). (In German).

In order to clarify the cleavage mechanism of $(CH_3CH_2)_2O$, α- and β-deuterated ethyl ether were chemically prepared in a special apparatus in high purity (yields up to 80%). Perdeuteroethylene-lithium was used as the organometallic compound, the reaction was observed by NMR spectroscopy. The α-d-diethyl ether decomposed as fast as $(CH_3CH_2)_2O$ (under β-elimination); cleavage of β-d-diethyl ether proceeded 4 to 5 times slower because of the isotope effects (4 months at 35°C), following three different mechanisms: mainly that of α′, β-(55 to 60%), and β-(35%), but also that of an α-(5 to 10%)-elimination. (GF)

2301 SOLVENT DEUTERIUM ISOTOPE EFFECT ON THE DISSOCIATION CONSTANT OF IODIC ACID. Gamsjaeger, H. (Univ., Bern); Gerber, F.; Antonsen, O. Chimia (Aarau); 27: No. 2, 94-97(15 Feb 1973).

The solubilities of hydrated and deuterated copper(II) iodate in $HClO_4-H_2O$ and $DClO_4-D_2O$ solutions, respectively, were measured at 1, 15, 25, and 35°C at perchloric acid concentrations from 0 to 1.0 m. These experimental results were used to calculate the solvent deuterium isotope effect, ΔpK, on the dissociation constants of HIO_3 and DIO_3. At ionic strength I = 1.0 m (Li)ClO_4 the following values were obtained, $\Delta pK = pK(D_2O) - pk(H_2O)$: 0.359 ± 0.027 (1°), 0.323 ± 0.015 (15°), 0.323 ± 0.047 (25°), 0.380 ± 0.025 (35°). (auth)

2302 DEUTERIUM ISOTOPE EFFECTS IN COMPLEXATION KINETICS. II. Lanthanide(III) Sulfate Systems. Reidler, J.; Silber, H. B. (Univ. of Maryland, Baltimore). J. Phys. Chem.; 77: No. 10, 1275-1280(10 May 1973).

The complexation reaction between La(III), Nd(III), Gd(III), and Dy(III) with SO_4^{2-} was investigated in H_2O and D_2O at 25°C. In all cases the complexation rate constant, k_{34}, and the dissociation rate constant, k_{43}, for each cation were different in the two solvents. The values of 10^{-3} k_{34} in H_2O and D_2O are La 0.84 and 0.24 sec^{-1}, Nd 1.9 and 0.80 sec^{-1}, Gd 8.2 and 6.9 sec^{-1}, and Dy 0.91 and 1.1 sec^{-1}; and 10^{-7} k_{43} equals La 3.8 and 7.0 sec^{-1}, Nd 4.8 and 7.1 sec^{-1}, Gd 3.8 and 0.74 sec^{-1}, and Dy 4.5 and 2.1 sec^{-1}. These data were compared to other lanthanide deuterium isotope studies to establish that the isotope effect is not a function of the solvated cation alone, but rather of the cation–ligand complex. (auth)

2303 ISOTOPE EFFECT ON THE LIFETIME OF EXCITED ETHANE. Malcolme-Lawes, D. J. (Kent Univ., Canterbury, Eng.). J. Chem. Soc., Chem. Commun.; No. 4, 146-147(21 Feb 1973).

The mean lifetimes of excited C_2H_5T and C_2D_5T are estimated from pressure dependence studies of the unimolecular decomposition reactions of these molecules following the substitution reaction with recoil tritium. (auth)

2304 STEREOCHEMICAL REQUIREMENTS FOR THE BETA–DEUTERIUM ISOTOPE EFFECT IN THE S_Ni DISPLACEMENT OF VINYL ESTERS. Maness, D. D.; Turrentine, L. D. (Univ. of Texas, Austin). Tetrahedron Lett.; No. 10, 755-757(Mar 1973).

To investigate transition state geometry and its effect on solvolyses of vinyl systems, the β-deuterium isotope effect was measured in a model system, 1-phenylethenyl fluorosulfonate. This compound and the 50 : 50 mixture of cis-trans monodeuterated fluorosulfonates were prepared by the addition of fluorosulfuric acid to ethynyl benzene and ethynyl-d-benzene respectively, as previously reported (Jones et al, J. Amer. Chem. Soc.; 92: 5457(1970)). These compounds were subjected to S_Ni acetolysis conditions, which led exclusively to the appropriate 1-phenylethenyl acetates. The reactions were followed by nmr, and the rate data obtained from the peak areas in the vinyl region. The results are reported. A substantial difference in the β-deuterium isotope effect between the two deuterio-isomers is observed. (auth)

2305 STUDIES ON SALT HYDRATES. IV. Thermal Decomposition of Lithium Halide Hydrates. Manewa, M.; Fritz, H. P. (Technical Univ., Munich). Z. Anorg. Allg. Chem.; 396: No. 3, 279-283(Feb 1973). (In German).

The thermal decomposition of $LiX \cdot nH_2O$ and $LiX \cdot nD_2O$ (X = Cl, Br, I; n = 1, 2, 3) is investigated on a thermobalance. There are differences in the stages of degradation depending on the starting hydrates and the anion radius. The thermal stability decreases with increasing quantity of water. Deuterates are of higher stability as hydrates. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 2232, 2364, and 2791.

2306 (GAT-675) URANIUM ISOTOPE SEPARATION BY CHEMICAL EXCHANGE REACTIONS BETWEEN UF_6 AND $NOUF_6$ IN A TWO PHASE LIQUID SYSTEM. Nugent, R. P. (Goodyear Atomic Corp., Piketon, Ohio). 5 Mar 1972. Contract AT(33-2)-1. 22p. Dep. NTIS $4.00.

An investigation was made to determine the feasibility of separating the isotopes of uranium by a chemical exchange method based on the reaction $NO^{235}UF_6 + {}^{238}UF_6 \rightleftharpoons NO^{238}UF_6 + {}^{235}UF_6$ with the ^{235}U isotope concentrating in the UF_6 species. Batch equilibrium tests indicated a separation factor, α, equal to 1.0016. A small diameter spray column was used to contact the two phases. Droplets of UF_6 dissolved in Freon 114 were passed downward through a column of $NOUF_6$ dissolved in anhydrous HF. The column was operated both without reflux and with reflux at one end. Difficulty was encountered in the reflux operation causing the run to be terminated prematurely and making the operational data inconclusive. Attempts were also made to determine the height of a transfer unit (HTU) by batch test methods. Analytical difficulties in detecting with sufficient reliability the small changes in isotopic concentration and system incongruities cast doubt on the applicability of these methods. (auth)

2307 TRITIUM LABELLING OF HYDROCARBONS BY SELF-RADIATION INDUCED EXCHANGE WITH HTO. Fong, D. H. J.; Garnett, J. L.; Long, M. A. (New South Wales Univ., Kensington). J. Label. Compounds; 8: No. 4, 695-700(1972).

The use is reported of radio-scanning gas chromatography in a thorough study of by-product formation during HTO induced exchange with aliphatic and aromatic hydrocarbons. The exchange procedure simply involved adding HTO to the organic compound under vacuum in a breakseal ampoule and heating to the required temperature. All saturated and unsaturated aliphatic and aromatic hydrocarbons studied may be labelled by this simple method. (auth)

2308 SYNTHESIS OF ORGANIC COMPOUNDS LABELLED WITH HYDROGEN ISOTOPES. I. Exchange of Halogen Atoms in Halohydrins for Hydrogen Isotopes to Prepare Alcohols Labelled with Deuterium or Tritium. Egyed, J.; Neszmelyi, A.; Beke, I.; Baitz, E. (Hungarian Academy of Sciences, Budapest). J. Label. Compounds; 8: No. 4, 607-613(1972).

A method was developed for the preparation of alcohols labelled with hydrogen isotopes, from halohydrins. The synthesis was performed via Grignard reagents in one step, in the course of which the halogen substituent has exchanged for magnesium, which then exchanges for the hydrogen isotope required. (auth)

2309 HYDROGEN–DEUTERIUM EXCHANGE AT A SATURATED CARBON ATOM IN TERTIARY PHOSPHINE COMPLEXES OF PLATINUM(II). Masters, C. (Koninklijke/Shell-Laboratorium, Amsterdam). J. Chem. Soc., Chem. Commun.; No. 5, 191-192(7 Mar 1973).

Complexes of the type $Pt_2Cl_4L_2$, where L = tri-n-propylphosphine (PPr_3) or tri-n-butylphosphine (PBu_3), undergo hydrogen–deuterium exchange in solution to give complexes containing deuterium in the tertiary phosphine, specifically at C–3 of the alkyl group. (auth)

2310 SEPARATION OF HYDROGEN AND TRITIUM ON A PALLADIUM FILTER. Ishutin, V. V.; Mekhedov, B. N.; Sukhotin, L. N. (Voronezh State Univ., USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 10, 1516-1517(Oct 1972).

Translated from Zh. Fiz. Khim.; 46: No. 10, 2561-2652 (Oct 1972).

^1H and ^3H were separated by diffusion rates at relative concentrations of 10^{-12} and hydrogen pressures in the range 60 to 250 torr. The results can be used to identify the temperature region (above 350°C) in which the tritium "memory" effect of the filter can be avoided, and the best region (200 to 250°C) for enriching with tritium gas samples of low specific activity. (auth)

2311 KINETICS OF THE TRITIUM ISOTOPE EXCHANGE BETWEEN PYRIDINE HYDROCHLORIDE AND HYDROGEN CHLORIDE. Szydlowski, J.; Zielinski, M. (Univ., Warsaw). Rocz. Chem.; 47: No. 1, 123-131(1973). (In Polish).

The tritium isotope exchange reaction between hydrogen chloride and pyridine hydrochloride (temperature interval from –70 to +70°C) was studied. The mechanism and rate of exchange are considered and the kinetics of tritium exchange is compared with that of ^{36}Cl. At higher temperatures the exchange rates are similar; at lower temperatures the differences appear due to association mechanism according to which the ^{36}Cl exchange proceeds. It is noted that the relatively fast kinetics and relatively large tritium isotope effect on equilibrium make the presented exchange reaction suitable for the enrichment and separation technology of hydrogen isotopes. (DHM)

2312 SEPARATION OF THE ISOTOPES OF POLYISOTOPIC ELEMENTS BY THE ION ELECTROMIGRATION METHOD IN MOLTEN SALTS. I. Steady State. Lyubimov, V. N.; Golyshev, S. I.; Tikhomirov, I. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 2, Ser. Khim. Nauk; No. 1, 3-9(Jan 1973). (In Russian).

The steady state that is reached in a separation tube after the separation of a multicomponent isotope mixture by the countercurrent electromigation method in molten salts was investigated. In the separation tube, which is connected with the infinite reservoir, only those isotopes are shown to be enriched that form either a light fraction or a heavy one; the content of the extreme isotope rises continuously when the distance from the open end of the tube increases, while the steady state concentrations of the middle isotopes passes the maxima. For molten $SnCl_2$ at 450°C in a separation tube of radius 0.2 cm, the effective diffusion coefficient was experimentally found to be $D_{\partial\phi} = 3 \cdot 10^{-4}$ cm^2/s and the velocities of stannous isotope ions were calculated relative to the key component for which the element as a whole was taken. With the use of these data the tin isotope distribution curves along the separation tube in the steady state were calculated. (auth)

2313 INFLUENCE OF THE SUBSTRATE ON HYDROGEN–WATER DEUTERIUM EXCHANGE OVER CARBON SUPPORTED PLATINUM. Sagert, N. H.; Pouteau, R. M. L. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Can. J. Chem.; 50: No. 22, 3686-3693(15 Nov 1972).

Rate data for hydrogen–water deuterium isotope exchange are reported for a number of platinum on carbon catalysts whose carbon supports were graphitized to varying degrees before the metal was deposited on them. The exchange over platinum black was studied for comparison. Over carbon supported catalysts, the rate was almost independent of hydrogen pressure and increased approximately linearly with water pressure. The rate controlling step seems to be the transfer of deuterium between chemisorbed hydrogen atoms and physisorbed HDO. Activation energies for the rate determining step decreased from 14 kcal/mol over unsupported platinum to as low as 2 kcal/mol over highly graphitized supports. Rates increased with heat treatment temperatures up to 2100°C. These effects are ascribed to electron transfer from the carbon support to the metal, resulting in a weaker Pt–H bond, and faster exchange. However they may be partially the result of non-linear adsorption of water. (auth)

2314 PRODUCTION OF PYROCATECHOL MULTIPLY LABELED WITH TRITIUM. Vdovenko, V. M.; Bobrova, V. N.; Rumyantseva, L. N.; Chernysheva, L. F.; Zharkov, A. V.; Volina, V. V. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 607-611 (1972).

Translated from Radiokhimiya; 14: No. 4, 592-596(1972).

The possibility of using the method of catalytic dehalogenation for the production of pyrocatechol multiply labeled with tritium was demonstrated. The conditions of synthesis permitting the production of 3,4,5,6-$^3H_4$-pyrocatechol with a specific activity of 2 Ci/mmole (19 Ci/g) of 96-97% radiochemical purity were developed. A convenient and effective method was used for the isolation of pyrocatechol: sublimation under vacuum, which permitted the isolation of this unstable, highly oxidizable product with a chemical yield equal to ~40%. Thin-layer chromatography with the introduction of a scintillator into the silica gel was developed for the separation of a mixture of pyrocatechol and tetrabromopyrocatechol and their identification. Two-dimensional thin-layer chromatography in the systems: (a) benzene–dioxane–acetic acid (95:25:4), (b) ethyl acetate–cyclohexane (1:4) was used to monitor the radiochemical purity of 3,4,5,6-$^3H_4$-pyrocatechol. (auth)

2315 ISOTOPE EXCHANGE BETWEEN HEPTA- AND HEXAVALENT NEPTUNIUM. Peretrukhin, V. F.; Krot, N. N.; Gel'man, A. D. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 644-645(1972).

Translated from Radiokhimiya; 14: No. 4, 628-629(1972).

A study was made of the isotopic exchange between Np(VII) and Np(VI) using ^{237}Np and ^{239}Np in which a method of separating the hexa- and heptavalent neptunium was developed based on the precipitation of the cobalt hexammine salt of Np(VII). Results show that 97 to 98% of the β activity was coprecipitated with the precipitate of heptavalent neptunium and 2 to 3% remained in solution. It was found that isotopic exchange between heptavalent and hexavalent neptunium in 0.3 to 0.5 M NaOH at concentration of 1.5 to 5×10^{-3} Np(VII) and 10^{-5} to 10^{-4} M Np(VI) is rapid and at room temperature goes to completion in less than 3 to 4 min. The high rate of isotopic exchange between Np(VII) and Np(VI) is still another evidence that the forms of existence of heptavalent and hexavalent neptunium in alkaline solutions are close in structure. (DHM)

2316 ISOTOPIC EXCHANGE OF ACTIVE METHYL HYDROGENS. VII. Kinetic Study of 2,4,6-Trimethylpyrylium Salts in Deuterium Oxide. Gard, E. (Inst. of Atomic Physics, Bucharest); Chiraleu, F.; Stanoiu, I. I.; Balaban, A. T. Rev. Roum. Chim.; 18: No. 2, 257-261(Feb 1973).

The NMR spectra at various temperatures and pH values, of buffered deuterium oxide solutions of 2,4,6-trimethylpyrylium chloride or trifluoromethanesulfonate show a rapid decrease of the 4-methyl proton peak and a slower decrease of the peak due to the 2- and 6-methyl protons. Rate constants, activation energies, and pH dependence indicate a mechanism of the exchange via methylenepyrans (anhydrobases). Nonbuffered solutions yield kinetic data indicating a pH lower than 1. (auth)

2317 ISOTOPE EXCHANGE REACTIONS BETWEEN Tl(III) COMPLEX AND ^{204}Tl. Cecal, A.; Schneider, I. A. (Univ., Iasi). Rev. Roum. Chim.; 18: No. 1, 35-42(Jan 1973). (In French).

The influence of some complex compounds of Tl(III) and the nature of the metal–ligand bond on the characteristic kinetic and thermodynamic parameters of the isotopic exchange reaction for the system $^{204}Tl(I)-Tl(III)$ was studied. The half reaction times, the velocity constants, the energies and entropies of activation, and also the preexponential factor were estimated. (tr-auth)

2318 POSSIBILITY OF FAST ISOTOPE EXCHANGE INVESTIGATIONS IN SOLUTIONS. Gosman, A. (Technical Univ., Prague). Z. Phys. Chem. (Leipzig); 251: No. 5-6, 411-413(1972).

New possibilities are described connected with the method of constant velocity supply of radioactive labeled component into the system. (DHM)

2319 KINETICS OF THE GAS-PHASE ISOTOPE EXCHANGE REACTION BETWEEN CH_4 AND H_2 LABELLED WITH TRITIUM. Kaminski, A. M.; Sobkowski, J. (Univ., Warsaw). Rocz. Chem.; 46: No. 12, 2283-2289(1972).

The rate of exchange of the hydrogen atom between H_2 and CH_4 in homogeneous gas phase reactions was measured using hydrogen labeled with tritium. The reaction was studied by a pulse technique and radiochromatographic method of analysis. A relation describing the rate of reaction is given. It was shown that the slow step of the reaction is the vibrational excitation of the H_2 molecule. (auth)

2320 PREPARATION OF TRITIUM-LABELLED TALC. Gangolli, S. D.; Crampton, R. F.; Lloyd, A. G. (British Industrial Biological Research Association, Carshalton, Eng.). Nature (London); 242: No. 5393, 113(9 Mar 1973).

Talc is known to produce biological effects such as tissue granulomata and a form of pneumoconiosis, and a recent report suggesting an association of cancer of the cervix and ovaries with the presence of talc particles at these sites has caused disquiet about its safety in use. The detection of talc particles in tissues presents considerable difficulties. The value of using a suitably labeled radioactive talc in biological studies is, however, obvious, and use of T-labeled asbestos has greatly facilitated localisation of asbestos fibres in tissues. A method is described for the preparation of T-labeled talc, involving two stages: first partial dehydration under controlled conditions, and second rehydration using tritiated water in the form of a benzene/water azeotropic mixture. (UK)

2321 INFLUENCE OF THE PROPERTIES OF ^{131}I PREPARATIONS ON THE LABELING OF POLYPEPTIDES USING THE CHLORAMINE-T METHOD. Kurcbart, H. (Comision Nacional de Energia Atomica, Buenos Aires); Quiroga, S.; Caro, R. A.; Radicella, R. Radiochim. Acta; 18: No. 2, 104-108(1972).

The labeling process of polypeptides with ^{131}I by means of the Chloramine-T method was studied in order to establish the optimal conditions for the utilization of the Na ^{131}I preparations. The chemical and the radiochemical properties of the Na^{131}I, as well as the quantity of inactive iodide added as isotopic carrier, determine the results of the labeling process, with regard to its yield, its reproducibility and the properties of the labeled molecule. If approximately 10 μCi of ^{131}I are used and no carrier iodide is added, the yields are relatively small and not reproducible. However, if certain quantities of inactive iodide are added to ^{131}I solutions of equivalent activity, the yield increases and becomes more reproducible. By studying the labeling yield of the polypeptides angiotensin-II and bovine thyrotrophin with ^{131}I as a function of the number of the total iodide atoms which are present per each molecule of the polypeptide, the optimal ratios for both compounds were determined. For angiotensin-II it was found that, if ratios higher than 4×10^{-3} iodide atoms per molecule of angiotensin are used, the yields are always greater than 80%. In the case of thyrotrophin, the yields reach a fairly well defined maximum of approximately 85% for a ratio of about 2 iodide atoms per molecule of thyrotrophin. In both cases the proportion of the radioactivity of the monoiodinated and the diiodinated tyrosine residues was determined; these values allowed us to calculate the relative amount of molecules having its tyrosine residues labeled with one or with two iodine atoms. Thus, the optimal ratio could be established between the quantity of iodine which has been used and the type of the labeled molecules in the total population of molecules. (auth)

2322 THERMODYNAMICS OF HYDROGEN-ISOTOPE EXCHANGE REACTIONS. Silvester, L. F. Davis, CA; Univ. of California (1972). 309p. University Microfilms Order No. 73-8352.

Thesis (Ph. D.).

The direct experimental determination of the equilibrium constants for the hydrogen-isotope-exchange reaction, $D_2(g) + 2HCl(DMF) = 2DCl(DMF) + H_2(g)$, where DMF is the solvent N,N-dimethylformamide, has been made. The reaction was studied in electrochemical double cells without liquid junction of the type $(Pt)D_2(g) \mid DCl(DMF) \mid TlCl(s) \mid Tl(Hg) \mid TlCl(s) \mid HCl(DMF) \mid H_2(g)(Pt)$. The experimentally determined values of ϵ° (296.6°K) for this cell are $\epsilon^\circ_{ion} = 7.64 \pm 0.38$ mV and $\epsilon^\circ_{neut} = 8.12 \pm 0.54$ mV, where ϵ°_{ion} refers to strong-electrolyte standard states for HCl (DMF) and DCl(DMF), and ϵ°_{neut} refers to undissociated-solute standard states for HCl(DMF) and DCl(DMF). The corresponding experimental values of the equilibrium constants are $K_{ion} = 1.82 \pm 0.05$, and $K_{neut} = 1.89 \pm 0.08$ (296.6°K). The experimental values of the equilibrium constants are compared with values for K calculated from statistical thermodynamic theory for model reactions. The dissociation constants for HCl and DCl in DMF were determined from conductance measurements. The experimentally determined dissociation constants are $K_{HCl} = 2.68 \pm 0.03 \times 10^{-4}$ and $K_{DCl} = 2.64 \pm 0.02 \times 10^{-4}$ (298.15°K) and yield an equilibrium constant $K = 1.02 \pm 0.04$ for the hydrogen-isotope-exchange reaction $H^+(DMF) + DCl(DMF) = HCl(DMF) + D^+(DMF)$ which is in agreement with the predicted value of $K = 1.02 \pm 0.04$ obtained from K_{ion} and K_{neut}. The limiting molar conductances for the HCl and DCl in DMF were found to be $\Lambda_0 = 79.85 \pm 0.82$ and $\Lambda_0 = 79.00 \pm 0.62$, respectively. (Diss. Abstr. Int., B)

2323 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN THE SOLVOLYSIS OF CYCLOBUTYL AND CYCLOPROPYLCARBINYL METHANESULFONATES. Goricnik, B.; Majerski, Z.; Borcic, S.; Sunko, D. E. (Inst. Rudjer Boskovic, Zagreb). J. Org. Chem.; 38: No. 10, 1881-1885(18 May 1973).

Deuterated cyclobutyl methanesulfonates and cyclopropylcarbinyl methanesulfonates were prepared and their solvolysis rates were measured in 60% aqueous diglyme. With cyclobutyl methanesulfonates, a reduced α effect, an inverse β effect, and a rather large normal γ effect were observed. These results indicate a strong 1−3 interaction in the transition state. The isotope effects found in solvolysis of cyclopropylcarbinyl methanesulfonates are inconclusive with respect to a possible bridging in the transition state. A degenerate internal rearrangement of cyclopropylcarbinyl methanesulfonate was demonstrated to occur during acetolysis. (auth)

Feed Materials Processing

2324 (AEMC/Chem.Engg-126) BIBLIOGRAPHY ON THE EXTRACTION OF URANIUM FROM SEA WATER. Khan, S.; Saleem, M. (Atomic Energy Minerals Centre, Lahore (Pakistan)). Jan 1973. 47p. Dep. NTIS (U. S. Sales Only) $4.50.

A bibliography of 56 references is presented on the extraction of uranium from seawater and other natural waters. References on other pertinent research, for example, the extraction of trace elements from seawater and the marine geochemistry of the uranium isotopes, are also included. Abstracts for each reference and an author index are provided. (JGB)

2325 URANIUM SOLUTION MINING PROCESS. Rhoades, V. W. (to Cities Service Oil Co.). U. S. Patent 3,713,698. 30 Jan 1973. Filed date 30 Mar 1971. 6p.

One or more production wells are drilled and completed into a uranium bearing formation having a high water saturation. The water saturation is removed from the area within the uranium formation by injecting a slug of an oxidant through the production wells. A series of injection wells is completed in the peripheral edge of the oxidant bank so that a leaching solution is injected into the water bank built up during oxidant injection. The solutions contact and react with the uranium mineral and oxidant to form soluble uranium salts which are produced from the production wells. (auth)

Radiation Chemistry

Refer also to abstracts 2804 and 3346.

2326 (BNL-tr-531) RADIOLYSIS OF AMMONIUM PERCHLORATE. Nevostruev, V. A.; Bugaenko, L. T.; Zakharov, Yu. A. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.) from Khim. Vys. Energ.; 1: No. 4, 406-407(1967). 10p. Dep. NTIS $3.00.

Single crystals and aqueous solutions of NH_4ClO_4 were irradiated using 4.7 MeV protons. Yields of Cl^-, Cl_2, ClO^-, and ClO_3^- are compared with previously reported results from γ radiolysis studies. (JGB)

2327 (CEA-CONF-2228) SPECTRA OF THE AMMONIATED ELECTRON IN THE PRESENCE OF AMIDE. Saito, E. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 10p. (CONF-720681-3). Dep. NTIS (U. S. Sales Only) $3.00.

From 3rd Weyl conference; Tel Aviv, Israel (19 Jun 1972).

In the determination of the near ir spectrum of the solvated electron in liquid ammonia, an anomaly, evidenced by a larger transparence of the solution, was observed at wavelengths corresponding to the bands of ammonia in the 1500 to 2300 nm region. This anomaly showed up in the studies of the electron formed by the chemical equilibrium $NH_2^- + 1/2\ H_2 \rightleftharpoons e^- + NH_3$ that is, in the presence of relatively high concentrations of KNH_2 and large hydrogen pressures. Under these circumstances it was difficult to attribute the cause of this anomaly to the solutes. Such solutions possess the property of stabilizing electrons created by photolysis or radiolysis and this characteristic was used to study the influence of the electron alone on this anomaly. Effectively, this anomaly increases with the concentration of the solvated electron which suggests the formation of a complex between e^-, KNH_2 and a certain number of ammonia molecules strongly linked so that they do not participate in the vibrational modes corresponding to the quoted wavelengths. (auth)

2328 (COO−3007-25) ROLE OF STRUCTURE AND ENERGY (OR IONIZATION) TRANSFER IN RADIATION CHEMISTRY AND BIOLOGY. Final Report. Trumbore, C. N. (Delaware Univ., Newark. Dept. of Chemistry). 1973. Contract AT(11-1)-3383. 27p. Dep. NTIS $3.50.

Substantial progress has been made in radiation chemical studies leading to a better understanding of: (1) rates of reaction of OH radicals in aqueous solution, (2) tests for energy transfer mechanisms in irradiated liquids, (3) the photolysis of water and

aqueous hydrogen peroxide solutions, (4) the radiation chemistry of a model DNA system (poly d(A-T)), (5) possible excited states in irradiated water, (6) the nature and time behavior of the "spur" in aqueous radiation chemistry (by a study of the influence of pulse dose on the hydrated electron decay rate in pulse radiolysis in the nanosecond region), and (7) the radiation chemistry of aqueous cysteine solutions. Extensive investigations of the blue-green algae have shown an unusually high radiation resistance for an organism in log phase growth. Radiation resistant strains of S. Calcicola have been established and new blue-green algal viruses have been isolated from polluted streams and their genetic differences have been characterized. Discontinuities in slopes of survival curves of irradiated viral suspensions have been correlated with differences in host range and plaque type of these irradiated viruses, suggesting that recombinations of "stimulated" viral DNA on a lysogenized chromosome may be one mechanism explaining radiation resistance of the algae. (auth)

2329 PULSE RADIOLYTIC INVESTIGATIONS OF SUPEROXIDE CATALYZED DISPROPORTIONATION. Mechanism for Bovine Superoxide Dismutase. Klug-Roth, D.; Fridovich, I.; Rabani, J. (Hebrew Univ., Jerusalem). J. Amer. Chem. Soc.; 95: No. 9, 2786-2790(2 May 1973).

Bovine superoxide dismutase was subjected to pulse radiolysis in the presence of O_2, EDTA, and formate. The reaction mechanism was investigated by means of optical measurements at 650 and 300 nm, in the presence and in the absence of catalase. The results can be explained on the basis of several reactions involving the enzyme. These are: (a) $E^0 + O_2^- \rightarrow E^- + O_2$, $k = (1.2 \pm 0.2) \times 10^9\ M^{-1}\ sec^{-1}$; (b) $E^- + O_2^- (+2H^+) \rightarrow E^0 + H_2O_2$, $k = (2.2 \pm 0.4) \times 10^9\ M^{-1}\ sec^{-1}$; (c) $E^- + O_2^- \rightarrow E^{2-} + O_2$, $k = (0\text{-}3) \times 10^8\ M^{-1}\ sec^{-1}$; (d) $E^{2-} + O_2^- (+2H^+) \rightarrow E^- + H_2O_2$, $k = (1.2 \pm 0.2) \times 10^8\ M^{-1}\ sec^{-1}$; (e) $E^0 + H_2O_2 \rightarrow E^{2-} + 2H^+ + O_2$; (f) $E^- + O_2 \rightarrow E^0 + O_2^-$, $k = 0.44 \pm 0.12\ M^{-1}\ sec^{-1}$. E^0 refers to the native enzyme in which both copper atoms are oxidized while E^- and E^{2-} refer to the singly and doubly reduced enzyme, respectively. Reactions a and b account for the activity of the enzyme in the absence of H_2O_2, whereas reactions a, b, and d account for the activity of the modified form of the enzyme which was generated by reaction with H_2O_2, as in reaction e. Reaction f describes the slow reoxidation of reduced enzyme which was observed in the presence of O_2. (auth)

2330 ELECTRON SPIN RESONANCE OF X-IRRADIATED SINGLE CRYSTALS OF L-THREONINE AT 77°K. Swenson, H.; Moulton, G. C. (Florida State Univ., Tallahassee). Radiat. Res.; 53: No. 3, 366-375(Mar 1973).

Electron spin resonance spectroscopy was used to study radiation damage at 77°K in single crystals of L-threonine. The cation radical and two other free radicals are trapped at 77°K. The g tensor for the cation radical is reported. The hyperfine tensors and g tensor are given for the free radical produced by deamination. Possible reaction mechanisms are suggested for the production of these free radicals. (auth)

2331 RADIATION CHEMISTRY OF GLYCYLGLYCINE IN OXYGEN-FREE SYSTEMS. Garrison, W. M.; Sokol, H. A.; Bennett Corniea, W. (Univ. of California, Berkeley). Radiat. Res.; 53: No. 3, 376-384(Mar 1973).

A study was made of the radiation chemistry of glycylglycine in oxygen-free systems. These include dilute and concentrated solutions as well as the solid state. Detailed reaction stoichiometries for each system are formulated on the basis of product analysis. Specific contributions of radicals, ions, and excited molecules in the formation of products are discussed. (auth)

2332 FREE RADICALS IN IRRADIATED NITRO-SUBSTITUTED PYRIMIDINES. Lorenz, P.; Benson, B. (Southern Illinois Univ., Carbondale). Radiat. Res.; 53: No. 3, 358-365(Mar 1973).

X-irradiated 5-nitrobarbituric acid, 5-nitroorotic acid, and 5-nitro-4,6-dihydroxypyrimidine show distinctive ESR spectra with very anisotropic nitrogen coupling, essentially the same as 5-nitrouracil. The 5-nitrouracil radical was identified as an iminoxyl radical formed by a mechanism which abstracts an oxygen from the nitro group leaving the unpaired electron coupling to the nitrogen of the nitro group. It is clear that these other nitropyrimidines yield similar iminoxyl radicals. The only reported nitropyrimidine which yields different radical structures is 5-nitro-6-methyluracil which has been investigated at 77°K and 300°K previously. On the basis of this experimental data, INDO molecular orbital calculations, and the proposed mechanism of formation of the 5-nitro uracil radical which fits also the other nitropyrimidines, radical structures are proposed for the low temperature and room temperature 5-nitro-6-methyluracil radicals. The proposed 77°K radical is formed by hydrogen addition to a nitro-oxygen leaving the unpaired electron coupling to this hydrogen and to the nitro-nitrogen. At room temperature the hydroxyl is abstracted from the nitro group leaving it a nitroso group, and a hydrogen is added to 0(4). INDO calculations on this structure give very good agreement to the reported experimental parameters. This radical differs from the previously reported structure by alteration of the nitro group into a nitroso. (auth)

2333 ULTRAVIOLET PHOTOBLEACHING OF FREE RADICALS CREATED IN γ-IRRADIATED AMINO ACIDS. Close, D. M.; Anderson, R. S. (Clark Univ., Worcester, MA). Radiat. Res.; 53: No. 3, 349-357(Mar 1973).

The electron paramagnetic resonance spectra of γ-irradiated single crystals of organic materials are often complicated by the creation of more than one free radical. Some complex EPR spectra were simplified by exposing the damaged crystals to intense ultraviolet light. In glycine, the damaging radiation creates $\dot{C}H_2COO^-$ and $N^+H_3\dot{C}HCOO^-$. A 15-second exposure to uv light removes the $\dot{C}H_2COO^-$ radical. In threonine, γ-irradiation creates two free radicals, neither of which has been previously identified. A one minute exposure to uv light temporarily removes one radical making it possible to identify the other radical as $CH_2\dot{C}(OH)$-$CH(N^+H_3)COO^-$. In malonic acid, malonamide, and adipic acid, unstable radicals are removed by uv photobleaching. When β-alanine is γ-irradiated at room temperature several unstable radicals are created. Exposure to uv light removes one radical and transforms another into a new radical. In leucine, γ-irradiation creates two radicals, neither of which were affected by a one minute exposure to the uv light. (auth)

2334 PRODUCTION OF EXCITED STATES BY LASERS AND IONIZING RADIATION. Thomas, J. K. (Univ. of Notre Dame, IN). Rec. Chem. Progr.; 32: No. 3, 145-163(1971). (COO-38-787).

The fundamental processes taking place in the low energy (<10 eV) excitation of a molecule, and the high energy (>100 eV) excitation of systems are described. The techniques of nsec laser photolysis, and nanosecond and picosecond pulse radiolysis together with low temperature irradiations are used to illustrate the arguments. Two model liquids are used, cyclohexane, or 3-methylhexane, and cumene or isopropylbenzene. It is concluded that in the alkanes, the excited states are formed mainly by ion neutralization, while in the aromatic systems, direct excitation to a variety of energy states could well explain the observed data. (auth)

2335 TREATMENT OF CHEMICALLY POLLUTED WATER BY IRRADIATION. Sunada, Tsuyoshi (Radiation Center of Osaka Prefecture, Sakai, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 496-498(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Problems in combating against environmental pollution are first reviewed. The reduction of pollutants in rivers, such as phenol, cyanide, and parathion, by irradiation using ^{60}Co γ rays or accelerated electrons was investigated with distilled water and river water. The effect is larger, as the dose rate is higher and pollutant concentration is lower. To obtain the same extent of removal, the river water requires a larger dose. The economic aspects of irradiation treatment are explained, referring also to the utilization of radioactive wastes from spent fuel. The existence of polychlorinated biphenyls (PCB) in rivers is a vital problem. An aqueous test solution of the PCB was irradiated with ^{60}Co γ rays. The PCB is highly resistant to radiolysis, while sedimentation treatment is effective, and a combination of both may be useful in town water works. (Japan)

2336 INVESTIGATION OF THE FORMATION AND CONVERSIONS OF RADICALS IN γ-IRRADIATED SOLID ISOBUTYLENE BY THE ESR METHOD. Shamonina, N. F.; Kotov, A. G. (Physical Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 422-423(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 478-479(1972).

Methallyl radicals have not previously been observed as expected in the ESR spectra of γ-irradiated solid isobutylene, although allyl-type radicals are present in almost all other irradiated solid olefins. Present studies on the action of light with $\lambda \geq 340$ mn on γ-irradiated isobutylene indicate that the original signal is transformed into a spectrum of 10 lines with splitting 22.4 Oe of the radical $(CH_3)_3\dot{C}$. Such a conversion can be associated only with the presence of allyl-type radicals, which are assumed to be methallyl. A mechanism for the conversion is discussed. (JGB)

2337 PECULIARITIES OF THE RADIOLYSIS OF METHANOL UNDER THE ACTION OF FISSION FRAGMENTS. Bulanov, L. A.; Starodubtseva, E. V.; Borisov, E. A. (Physical Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 420-421(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 476-478(1972).

Experiments were conducted on the radiolysis of methanol under the action of fission fragments, using aluminum foils coated with layers of uranium octoxide of different thicknesses (0.45 to 45 mg/cm^2). Results indicated an increase in the radiation yield of a number of products with increasing thickness of the source of fission fragments, particularly in the case of ethylene glycol, and to a lesser extent with formaldehyde, CO, CH_4, and H_2. Because of large experimental errors, firm conclusions could not be reached, but from available data it follows that the radiation yield of the product depends on the velocity of the fission fragment. (JGB)

2338 RADIOLYSIS OF AQUEOUS SOLUTIONS OF FRAGMENTS OF NUCLEIC ACIDS. Reactions of Pyrimidyl Radicals with Alcohol. Fel, N. S.; Zaozerskaya, L. A.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 418-419(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 475-476(1972).

The reactivity of the radicals formed by the addition of OH or e^-_{aq} to pyrimidine bases (PB) – PB + OH = R_1 and PB + e^-_{aq} = R_2 was studied. The relative rate constants of the reactions of these radicals with methanol were determined by the method of stationary concentrations. The radiation decomposition of methanol was measured in two systems (pH ~ 7): (A) thymine (6×10^{-3} M) + CH_3OH (4.3×10^{-3} M) + N_2O (~2.5×10^{-2} M); (B) thymine (1×10^{-3} M) + CH_3OH (2×10^{-1} M) + He (1 atm). The concentration of CH_3OH in solution was measured by gas–liquid chromatography. (auth)

2339 OPTICAL ABSORPTION SPECTRA AND MOBILITY OF SOLVATED ELECTRONS IN ALIPHATIC ALCOHOLS. Rudnev, A. V.; Vannikov, A. V.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 416-417(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 473-475(1972).

Data on combined electrical and optical measurements of characteristics of the solvated electron in the pulse radiolysis of alcohols are presented. Studies were conducted at 20°C on the following alcohols: isopropyl, n-butyl, isobutyl, sec-butyl, tert-butyl, n-amyl, isoamyl, and n-hexyl alcohols and ethylene glycol. Relaxation current curves are plotted for ethylene glycol, isopropanol, and n-butanol. The mobility of e^-_{solv} and of short-lived molecular ions as functions of the reciprocal of the alcohol viscosity are given. Optical absorption spectra of e^-_{solv} for four alcohols are also given. (JGB)

2340 INTERACTION OF ELECTRONS WITH MONOMERS IN THE RADIOLYSIS AND PHOTOLYSIS OF ETHANOL. IV. Photolysis at 100 to 114°K; Mechanism and Thermochemistry of Photolysis. Vasil'ev, V. G.; Verein, N. V.; Piskunov, A. K. (Physical-Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 414-415(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 471-472(1972).

A probable mechanism for the aniline-sensitized photolysis of ethanol at 77 to 114°K is reported. The enthalpy of formation of various radicals and e^-_T in an ethanol matrix are estimated. The enthalpy of dissolution of e^-_m and An^{+} (radical cation of aniline) in the matrix was also calculated, taking into account the polarization energy of the matrix. (JGB)

2341 DETERMINATION OF YIELDS OF MOLECULAR PRODUCTS FROM THE RADIOLYSIS OF WATER BY POTENTIOSTATIC COULOMETRY. Effect of pH. Raichevskii, G.; Pangarov, N. (Inst. of Physical Chemistry, Sofia). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 407-413(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 462-470(1972).

Potentiostatic coulometry was used to measure observed radiation yields of molecular H_2 and H_2O_2 produced during reversible radiolysis of water in an inert medium, working with solutions free of acceptors or additives, and with zero free volume above the liquid phase. The directly measured H_2 and H_2O_2 yields proved to be practically identical and almost one whole order of magnitude lower than the initial yields reported in the literature. The relationship between measured yields and the pH, over the 2 to 14 pH range was also studied. Kinetic analysis indicated that the yields fell off sharply with increasing pH. Graphs showing the variation of $G(H_2)$ and $G(H_2O_2)$ with pH were used to confirm the assumption that dissociative processes alter both the structure and properties of the primary radical products in the 2 to 5 and 9 to 10.5 pH ranges, and at pH values equal to or in excess of 12.5. (auth)

2342 EFFECT OF LINEAR ENERGY TRANSFER ON THE RADIATION YIELD IN THE DECOMPOSITION OF WATER IN 0.4 M H_2SO_4. Vladimirova, M. V. High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 403-406(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 458-461(1972).

A discussion is presented on the effects of linear energy transfer (LET) on radiation yields, G_{-H_2O} for the breakdown of water and G'_{H_2O} for the breakdown of water with suppression of the track reactions: (a) $H_2O_2 + OH \rightarrow HO_2 + H_2O$; (b) $H_2 + OH \rightarrow H + H_2O$; and (c) $H_2O_2 + H \rightarrow OH + H_2O$ in solution. Data are shown to satisfy the equations $G'_{-H_2O} = G_{-H_2O} + G(a) + G(b) + G(c) = G_{-H_2O} + 5G_{HO_2}$. The data of the literature were used to derive empirical equations relating the yield of products from the α radiolysis of water with the LET. Values of G_{HO_2} and G'_{-H_2O} were calculated for LET in the 0.02 to 25 eV/Å range. The value of G'_{-H_2O} falls off from 4.5 to 4 molecules/100 eV in the 0.02 to 0.5 eV/Å LET range, but again rises to 4.2 molecules/100 eV for LET in excess of 0.5 eV/Å. This increase is explained as a result of the participation of isolated excited molecules in the formation of water radiolysis molecular products. An estimate is made of the yield of those excited molecules which participate in the formation of H_2 and H_2O_2. (auth)

2343 INVESTIGATION OF THE PECULIARITIES OF THE THERMAL OXIDATION OF IRRADIATED POLYOLEFINS. Pavlova, Zh. D.; Leshchenko, S. S.; Egorova, Z. S.; Karpov, V. L. (Physical-Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 397-402(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 451-457(1972).

The peculiarities of the thermal oxidation of low-density polyethylene (PELD), high-density polyethylene (PEHD), and a copolymer of ethylene with 7 mole % propylene (CEP-7), γ-irradiated in the dose range from 10 up to 100 Mrad, were studied. It was found that the thermooxidative stability drops with increasing dose of irradiation. The basic oxidation products are aldehydes, ketones, ethers, and peracids. In nonirradiated branched PELD and CEP-7, primarily the side groups and tertiary carbon atoms are oxidized; in nonirradiated linear PEHD, oxidation occurs chiefly with the participation of secondary carbon atoms. The initial structure of the nonirradiated polymers influences the course of the oxidation of irradiated polymers. It was established that the most vulnerable places in the oxidation of irradiated polymers are the cross-links and tertiary carbon atoms. It was found that simultaneously with the process of destruction in the oxidation of irradiated polymers, structuration with the formation of ether bonds occurs. (auth)

2344 OXIDATION OF ISOMERS OF METHYLCYCLOHEXANOL UNDER THE ACTION OF RADIATION. Ladygin, B. Ya.; Furman, M. S.; Mogilev, V. I. (State Scientific Research and Planning Inst. of the Nitrogen Industry and Products of Organic Synthesis, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 394-396(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 451-457(1972).

The influence of the temperature and ^{60}Co γ radiation dose rate on the liquid-phase oxidation of isomers of methylcyclohexanol (MCH) was studied. It was established that in the developed process hydrogen peroxide and the corresponding methylcyclohexanone are accumulated in equimolar amounts and evidently arise from the initially formed cyclic α-hydroxy hydroperoxide. The ratios of the rate constants of the reactions of propagation ($k^{1/2}$) and termination (k_0) of chains were determined (liters$^{1/2}$ × mole$^{-1/2}$ × sec$^{-1/2}$: $k_p k_0^{-1/2}$)$_2$-MCH = 2.1×10^8 exp (−18,600/RT), $k\,k_0^{-1/2}$)$_3$-MCH = 2.3×10^5 exp (−13,000/RT), ($k_p k_0^{-1/2}$)$_4$-MCH = 1.3×10^4 exp (−11,000/RT). The introduction of a methyl group into the cyclohexanol molecule in the metaposition and especially in the orthoposition substantially increases the activation energy of the reaction of propagation of the kinetic chains and hinders the process of recombination of peroxide radicals. (auth)

2345 INTERACTION OF ELECTRONS WITH MONOMERS IN THE RADIOLYSIS AND PHOTOLYSIS OF ETHANOL. III. Photolysis in the Presence of Isobutylene, Acetylene, and Acetaldehyde. The Electron Affinity of the C_2H_5O Free Radical. Vasil'ev, V. G.; Verein, N. V.; Piskunov, A. K. (Physical-Chemical Inst., Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 374-376(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 425-427(1972).

The heat of formation of the ethoxide anion and the electron affinity of the ethoxyl radical were determined from the results of an investigation into the photochemical reaction which takes place in frozen ethanolic solutions of an arylamine between secondary electrons and additions of unsaturated compounds. (auth)

2346 ESR MEASUREMENT OF TRANSIENT RADICALS IN SOLIDS UNDER IRRADIATION. Shiraishi, H.; Kadoi, H.; Hasegawa, K.; Tabata, Y.; Oshima, K. (Tokyo Univ.). Proc. Jap. Conf. Radioisotop.; No. 10, 401-403(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A method to measure directly short-lived active nuclides by

observing their ESR during electron irradiation has already been studied in foreign countries, and recently the measurement came to be available in the Faculty of Engineering, University of Tokyo. The accelerator used is Dynamitron, an improved Cockcroft type, and is operated at a voltage of 1 to 1.5 MeV, and a current of 10 to 200 μA for the ESR measurement. Samples are commercially available cyclohexane and tetramethylbutane (TMB). Radicals generated in the irradiation are fixed to the cyclohexyl radical, which quickly disappears at the temperature above the phase transition point. Under these experimental conditions, the observed radicals seem to be distributed almost uniformly and to disappear by reaction with each other after diffusing through the crystals. For 2,2,3,3-tetramethylbutane, there are seventeen peaks in the spectra measured immediately after the electron beam irradiation at −113°C, and three kinds of the radicals seem to be principal radicals when the ratio of intensity is taken into consideration. (Japan)

2347 GAMMA-INDUCED ADDITION OF DIALKYL PHOSPHITES TO OLEFINS AND PYROLYSIS OF THE 1:1 ADDUCTS. Yamagami, M.; Nakao, R.; Fukumoto, T.; Tsurugi, J. (Radiation Center of Osaka Prefecture, Sakai, Japan). Nippon Kagaku Kaishi; 1972: No. 10, 1991-1993(Oct 1972). (In Japanese).

γ-Induced addition of dimethyl, diethyl, and di-n-propyl phosphites to vinyl acetate yielded the 1:1 and 1:2 adducts. Similar addition of dimethyl phosphite to allyl acetate gave the 1:1 adduct. Dimethyl 2-acetoxyethylphosphite and dimethyl 3-acetoxypropylphosphite thus obtained as the 1:1 adducts were pyrolyzed to yield dimethyl vinylphosphite and dimethyl allylphosphite, respectively. However, diethyl and di-n-propyl 2-acetoxyethylphosphites gave complicated pyrolytic products, ethylene and propylene, respectively, besides acetic acid. (auth)

2348 RECOMBINATION LUMINESCENCE AND ELECTRON STABILIZATION IN ALKYLKETONES IRRADIATED AT 77°K. Kostin, A. K.; Kulakov, V. V.; Nikol'skii, V. G.; Bakh, N. A. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 388-390(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 440-443(1972).

An investigation was carried out into the rate of radiophotoluminescence (RPL) damping in a number of γ-irradiated methyl alkyl and dialkyl ketones exposed to pulses of infrared light (λ 800 nm) at 77°K. The RPL of dialkyl ketones dies down after less than 10^{-3} sec, whereas luminescence from methyl alkyl ketones is observed over tenths of seconds. A prolonged RPL afterglow is observed only when e^-_{tr} is detected by ESR. Differences in the damping rates are associated with the type of stabilization of the electrons. The intensity and damping time of RPL depend on the absorbed dose and are reduced on increasing the dose above ~1 Mrad. (auth)

2349 RADIOLYSIS OF TRIS(ETHYLENEDIAMINE)COBALT (III) SALTS. Witiak, D. Ames, IA; Iowa State Univ. (1972). 96p. University Microfilms Order No. 73-9501.

Thesis (Ph. D.).

The effects of radiation on the optically active coordination compounds $[Co(en)_3]X_3$ (where X = Cl^-, Br^-, I^- and NO_3^-) were studied in the solid state. Thermal racemization, x- and gamma-induced effects as well as the crystal structure of the nitrate salt were studied. The rate of loss of optical activity was in the order $I^- > Br^- > Cl^- > NO_3^-$ for the various forms of radiation. The activation energy for thermal racemization of the nitrate salt was about four times larger than for the various halide salts. This was attributed to the greater number of possible hydrogen bonds between the oxygens of the nitrate group and the amine hydrogens. A compound, with elemental composition $C_2H_6N_2$, was observed after the x-bombardment of $[Co(en)_3](NO_3)_3$. Identification of the exact geometry of the compound has not been solved at this time. The crystal structure of D-$[Co(en)_3](NO_3)_3$ was determined using three-dimensional single-crystal x-ray techniques. The compound crystallized in the orthorhombic space group $P2_12_12_1$. The lattice constants were a = 14.570 A, b = 12.607 A, and c = 8.756 A, with four formula units in the unit cell. Atoms of Co, N, C, and O were refined anisotropically. The derived structure was refined by least-squares methods to an unweighted R index of 8.4%. The coordination about the cobalt atom was essentially octahedral with an average Co−N distance of 1.974 ± 0.008 A. (Diss. Abstr. Int., B)

2350 RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS OF ALIPHATIC HYDROCARBONS. Soeylemez, T. Pittsburgh; Carnegie-Mellon Univ. (1973). 107p. University Microfilms Order No. 73-9140.

Thesis (Ph. D.).

Detailed analyses of the products formed in the γ radiolysis of acidic (pH 3) and N_2O saturated aqueous solutions of cyclopentane and cyclopentene were carried out. Because these products are formed in extremely low concentrations, C-14 labeled cyclopentane and cyclopentene were used. For the product analysis a radiogas chromatographic technique was developed. The reactivities of these compounds, as well as a number of other related compounds, with the primary radicals produced in water were measured by pulse radiolysis and steady-state competition methods. The secondary radicals formed in these reactions were examined by electron spin resonance and pulse radiolysis methods. The absolute rate for radical−radical reactions was determined by pulse radiolysis, and it was found that the unsaturated radicals produced by H abstraction from cyclopentene react somewhat less rapidly than the saturated radicals produced from cyclopentane. Data on cyclopentene were quantitatively interpreted in terms of the ratios of the rate constants of disproportionation to combination reactions of hydrocarbon radicals and the fractions of H atoms and OH radicals which add to and abstract from cyclopentene. Values of the kinetic parameters determined from the radiolysis of cyclopentene solutions were then applied to predict the product formation in the case of cyclopentane. It is shown that for saturated solutions of cyclopentane, cyclopentene should build up to a plateau level of 3×10^{-5} M for acidic solutions and 8×10^{-5} M for N_2O saturated solutions. In general there is an excellent agreement between the experimental and predicted values for the dependence of the yield on dose and the plateau values. (Diss. Abstr. Int., B)

2351 CAPTURE OF PRECURSORS OF HYDRAZINE BY Cu^+ IONS IN THE COURSE OF γ RADIOLYSIS OF LIQUID AMMONIA. Delcourt, M. O.; Belloni, J. (Paris Univ.). Radiochem. Radioanal. Lett.; 13: No. 5-6, 329-338(30 Apr 1973). (In French).

γ radiolysis studies at +20 and −55°C of solutions of the reducing ions Cu^+ in NH_3 confirm that part of the precursors of N_2H_4 can be scavenged. These precursors seem to be NH radicals in the triplet state having a fairly long lifetime, liable either to form hydrazine by slow insertion into the NH_3 molecule or to react with reducing solutes. The following primary yields are obtained: at 20°: $G_{N_2H_4} = 0.35 \pm 0.05$; $G_{NH} = 0.29 \pm 0.05$ and at −55°C: $G_{N_2H_4} = 0.40$; $G_{NH} = 0.13$. (auth)

2352 MOBILITIES AND RANGES OF ELECTRONS IN LIQUIDS: EFFECT OF MOLECULAR STRUCTURE IN C_5-C_{12} ALKANES. Dodelet, J. P.; Freeman, G. R. (Univ. of Alberta, Edmonton). Can. J. Chem.; 50: No. 16, 2667-2679(15 Aug 1972).

X-radiolysis free ion yields and electron mobilities were measured in a series of branched chain hydrocarbons at several temperatures. The numbers listed after the following compounds are the temperature (K), G_{fi}, most probable penetration range of the secondary electrons (Å) and thermal electron mobility (cm^2/V s): 2,2-dimethylpropane (neopentane), 294, 1.09, 213, 50; 2,2,3,3-tetramethylbutane, 379, 0.80, 130; 2,2,4,4-tetramethylpentane, 295, 0.83, 158, 24; 2,2,5,5-tetramethylhexane, 293, 0.67, 138, 12; 2,2,6,6-tetramethylheptane, 293, 0.47, 113; 2,2,7,7-tetramethyloctane, 383, 0.58, 100; 2,2,3,3-tetramethylpentane, 295, 0.42, 102, 5.2; cyclohexane, 294, 0.16, 67, 0.45. The difference between the activation energies of the reactions

$$[M^+ + e^-] \rightarrow \text{geminate neutralization and}$$
$$[M^+ + e^-] \rightarrow \text{free ions}$$

is $(E_{15} - E_{14})$ ~ (2 to 3) RT for twenty two different hydrocarbons, including olefins and benzene. The rate of energy loss by epithermal electrons in liquid hydrocarbons increases with increasing anisotropy of polarizability of the molecules or groups; the range of the electron interaction in a given molecule appears to be about two C−C bonds in series (groups up to neopentyl in size). There is a correlation between the mobilities of thermal electrons in liquids and the penetration ranges of the secondary electrons in the liquids. The electron mobility in a liquid alkane appears to be limited by inelastic scattering. The inelastic scattering cross sections for both thermal (<0.1 eV) and epithermal (~1 eV) electrons in liquid alkanes are affected in similar ways by the anisotropy of polarizability of the molecules. In both instances the scattering apparently involves rotational (librational) excitation of the medium. (auth)

2353 OPTICAL AND THERMAL BLEACHING OF TRAPPED ELECTRONS IN ALIPHATIC AMINE GLASSES. Noda, S.; Fueki, K.; Kuri, A. I. (Nagoya Univ., Japan). Can. J. Chem.; 50: No. 16, 2699-2701(15 Aug 1972).

An optical bleaching study was made of trapped electrons in γ-irradiated aliphatic amines at −196°C. The results indicate that the optical absorption of the trapped electrons in the amines is attributed to optical transitions to both bound excited states and a continuum state. The thermal decay of the trapped elec-

trons was studied by the esr technique at temperatures above −196°C. It was found that the line width of the ESR spectra of the trapped electrons in some of the amines changes on warming. (auth)

2354 COMPARISON BETWEEN MOLECULAR STRUCTURE EFFECTS IN TRIPLET POSITRONIUM ANNIHILATION RATES AND RADIOLYSIS FREE ION YIELDS IN LIQUID HYDROCARBONS. Freeman, G. R.; Dodelet, J. P. (Univ. of Alberta, Edmonton). Can. J. Chem.; 50: No. 16, 2697-2698(15 Aug 1972).

Two seemingly unrelated phenomena in liquid hydrocarbons have similar trends in their dependences upon the molecular structure of the hydrocarbon. The phenomena are the annihilation half-life of triplet positronium and the radiolysis free ion yield. In n-alkanes the effect of increasing the molecular chain length, upon both phenomena, appears to be simply to increase the density of interacting sites. Branching the alkane chain decreases the strength of molecular interaction with both electrons and positronium, although the relative decrease is much greater for the former than for the latter. The effects of double bonds on the phenomena, after separating out the density effect, are different from each other. (auth)

2355 REACTIVITY OF ORGANIC HALIDES TOWARD THE MOBILE ELECTRON IN METHYLTETRAHYDROFURAN GLASS. Kato, N.; Fueki, K.; Kuri, Z. I. (Nagoya Univ., Japan). Can. J. Chem.; 50: No. 16, 2702-2704(15 Aug 1972).

The relative reactivity of a number of organic halides with the mobile electron produced in γ-irradiated methyltetrahydrofuran glass at 77°K was studied by a scavenger competition kinetics. It was found that for the organic halides there exists a correlation between the relative electron capture cross section in the glassy matrix and the heat of reaction for dissociative electron capture estimated from gas phase data. (auth)

2356 RADIOLYSIS OF HYDROCARBONS IN INCLUSION COMPOUNDS WITH UREA. Karasev, A. L. (Inst. of Electrochemistry, Moscow). High Energy Chem. (USSR) (Engl. Transl.); 6: No. 5, 391-393(1972).

Translated from Khim. Vys. Energ.; 6: No. 5, 444-446(1972).

The radiolysis of inclusion compounds of heptane, decane, hexadecane, and 1-heptene with urea was studied. It was found that in the γ-irradiation of inclusion compounds of alkanes, alkyl radicals and captured electrons are formed. The latter disappear under the action of visible light without the formation of other paramagnetic centers. In the radiolysis of inclusion compounds of 1-heptene with urea, alkyl radicals, captured electrons, and molecular cation-radicals are formed. Under the action of visible light, e^-_{capt} are quantitatively converted to alkyl radicals. The cation radicals are also converted to alkyl radicals in the case of prolonged exposure of the samples to liquid nitrogen. A mechanism for these conversions is proposed. (auth)

2357 RADIATION RESISTANCE OF CHITIN AND CHITOSAN APPLIED IN THE CHROMATOGRAPHY OF RADIOACTIVE SOLUTIONS. Muzzarelli, R. A. A.; Tubertini, O. (Univ., Bologna). J. Radioanal. Chem.; 12: No. 2, 431-440(Dec 1972).

Chitin and chitosan were γ-irradiated in acidic solutions containing a decontaminating soap. It has been shown that these powders suspended in aqueous media do not undergo radiolysis, as their ir spectra are not altered, and there is no radiolysis product in the solution, except for the case of nitric acid at low pH where some chitosan is present in dissolved form. These polymers therefore exhibit very good radiation resistance, in spite of the fact that the monomers undergo very rapid radiolysis. ^{60}Co radiations up to 50,000 krad were used. Under these conditions, chitosan does not lose its collection capacity for most of the metal ions of interest in the nuclear field, including cobalt, that can be collected from decontaminating soap solutions with a volume reduction of 10. (auth)

2358 INVESTIGATION OF THE STABILITY OF NAPHTHALENE AND POPOP, SUBJECTED TO LARGE DOSES OF γ IRRADIATION, BY THE METHODS OF SPECTRAL AND POLAROGRAPHIC ANALYSES. Malinovskaya, S. A.; Gunder, O. A.; Rubis, A. I.; Koba, V. S.; Alekseeva, T. A.; Bezuglyi, V. D. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 627-631(1972).

Translated from Radiokhimiya; 14: No. 4, 613-617(1972).

The stability of naphthalene and 2,2′-p-phenylenebis(5-phenyloxazole) (POPOP) in the crystalline state and in poly(methyl methacrylate) (PMMA) solution, as well as the change in the concentration of the residual monomer (MMA) during γ irradiation, were investigated. On the basis of the data of polarographic analysis the absence of a material loss of POPOP and naphthalene and change in the concentration of the residual monomer up to a dose of 22 Mrad were established. The weight loss of naphthalene was detected only in the case of irradiation with a dose of 168 Mrad. A drop in the photoluminescence of solutions of irradiated naphthalene and the appearance of new long-wave maxima were detected. Radiolysis products of naphthalene were isolated and investigated. On the basis of the ir spectra and fluorescence spectra it was hypothesized that associated molecules of different molecular compositions are present. The decrease in the scintillation effectiveness of PS and their photoluminescence as a result of the action of γ irradiation should be explained chiefly by quenching by the radiolysis products and a decrease in the transparency of the polymer matrix. (auth)

2359 PULSE RADIOLYSIS OF AQUEOUS PAPAIN. Clement, J. R. (Univ. of Calgary, Alberta); Armstrong, D. A.; Klassen, N. V.; Gillis, H. A. Can. J. Chem.; 50: No. 17, 2833-2840(1 Sep 1972).

The pulse radiolysis of the proteolytic enzyme papain was studied in nitrogen-purged and N_2O-purged aqueous solutions at pH 6.4. The rate constant for reaction of OH with papain is 4.7×10^{10} M^{-1} s^{-1}. The initial spectrum of the intermediate formed by this radical is consistent with a major fraction of attack at tyrosine residues with smaller proportions reacting at tryptophan and other sites. Subsequent spectral changes are also consistent with the preferential attack of OH on tyrosine. The overall rate constant for reaction of e^-_{aq} with papain is 4.1×10^{10} M^{-1} s^{-1} and the spectrum of the electron adduct closely resembles that of the disulfide anion $-SS^{=}$. However, there is evidence that not all reactions e^-_{aq} with papain lead to the formation of this species. The results are discussed in the light of deactivation yields for ^{60}Co γ radiolysis measured by biochemical techniques. (auth)

2360 E. S. R. STUDIES OF γ-RAY IRRADIATED SINGLE CRYSTALS OF D-TARTARIC ACID. Mulchinock, J. K. (Univ. of Guelph, Ont.); Hallett, F. R.; Adam, F. C. Can. J. Chem.; 50: No. 22, 3706-3713(15 Nov 1972).

Electron spin resonance (ESR) studies on single crystals of normal and deuterated D-tartaric acid were carried out as part of a larger investigation of radical production and migration in biologically related single crystals. The D-tartaric acid system is especially interesting since the second and third carbon atoms of the molecule, which are chemically identical in solution, become conformationally non-equivalent in the unit cell. The effects of this conformational difference on the ESR spectra are discussed. The radicals identified in this study are consistent with the work of others on similar systems. (auth)

2361 SYNTHESIS AND INVESTIGATION OF THE PROPERTIES OF POLYACRYLONITRILE CONTAINING BASIC GROUPS. Ryasnoi, V. D.; Arkhiptsev, V. M.; Salamatov, I. I. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 13-18(1972). (In Russian).

Polyvinylamine was introduced during γ-induced polymerization of acrylonitrile in order to improve the sorptive properties for dyes and improve filament-forming properties of the resulting polymer. The polyvinylamine regulates the molecular weight of the polymer. The following conditions of polymerization were studied: pH, duration of synthesis, type of initiation, viscosity of polymer, and the quantity of basic groups. (DHM)

2362 CALCULATION OF THE RADIATION CHEMICAL YIELD UNDER CHANNEL CONDITIONS AT VARYING LOOP TEMPERATURES. Kalyazin, E. P.; Kovaleva, E. P.; Petryaev, E. P. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk Belarus. SSR, Ser. Fiz.-Energ. Navuk; No. 1, 19-20(1972). (In Russian).

The principles of calculating the radiation chemical yields for single-pass system at different temperatures are presented. The yield (molecules/100 eV) was expressed in the magnitude of the absorbed dose of radiation, the density of the system, the volume of the irradiator, and flow rate through the irradiation zone, and Avogadro's number. (KSW)

2363 PULSE RADIOLYTIC POLAROGRAPHY: THE REDUCTION OF THE ASCORBIC ACID RADICAL AND OF THE FERRIHEXACYANIDE ANION AT THE MERCURY ELECTRODE. Graetzel, M.; Henglein, A. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 77: No. 1, 2-6(1973).

The relatively long lived ascorbic acid radical or the ferrihexacyanide anion were produced by a 20 ns pulse of high energy electrons in N_2O saturated, 10^{-3} molar solutions of ascorbic acid or ferrohexacyanide anion, respectively. Their cathodic currents at a hanging mercury drop electrode were recorded as a function of time in the micro to millisecond range. The analysis of current-time curves at constant potential was carried out in the same way as in the single potential jump experiments of conventional electrochemistry. Absolute values of the rate constant of the transfer processes could be obtained for various potentials. The transfer coefficient was found to be 0.23 for the ascorbic acid radical and 0.15 for the ferrihexacyanide anion. The exchange current density at the standard potential of the system $[Fe(CN)_6]^{3-}/[Fe(CN)_6]^{4-}$

was calculated as 3.5 mA × cm^{-2} at a concentration of 10^{-3} M. (GF)

2364 RADIOLYTIC DEUTERIUM–HYDROGEN EXCHANGE AS THE FASTEST IONIC EXCHANGE PROCESS. Kulazhenkova, N. A.; Larin, I. K.; Tal'roze, V. L. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 1, 129-132(1 Nov 1972). (In Russian).

The effect of a constant electric field on the exchange rate in the ^{60}Co γ-induced deuterium–hydrogen exchange reaction was studied, in which the triatomic radicals are assumed to participate: $H_2D^+ + D_2 \rightarrow HD_2^+ + HD$. The electric field generated was permitted to have values from zero to 1800 V. For a yield of HD molecule per ion pair = 1.5×10^7, the electric decreased the exchange rate by a factor of 100. The yield of HD was also measured as functions of the pressure of the system and the magnitude of the dose. (KSW)

2365 FROZEN AQUEOUS SOLUTIONS OF POLYOLS IRRADIATED AT 77°K, AND THEIR EPR BEHAVIOR AT 77 TO 190°K. Nikitin, I. V.; Miroshnichenko, I. V.; Kudryashov, L. I.; Dyatkina, M. E.; Kochetkov, N. K. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 4, 871-873(1 Dec 1972). (In Russian).

Radicals which were induced by ^{60}Co radiation at 77°C of ribitol, xylitol, arabitol, dulcitol, sorbitol, and mannitol were studied by EPR between 77 and 190°K. In all polyols, the radiation produced a dark violet coloration at 77°K, and a singlet representing a stabilized electron, and evidence of a radical ȮH and radicals with a doublet s.t.s. were in evidence in most polyols. (KSW)

2366 RADIATION-INDUCED TERNARY COPOLYMERIZATION OF VINYL FLUORIDE, VINYL ACETATE, AND ACRYLIC ACID. Usmanov, Kh. U.; Yul'chibaev, A. A.; Aslanova, R. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 3, 33-34(1972). (In Russian).

The kinetics of the ternary copolymerization of vinyl fluoride, vinyl acetate, and acrylic acid were studied during the irradiation of the mixture with 16, 50, and 70 R/sec of ^{60}Co-emitted γ radiation at 34°C. The yield of copolymer was raised by increasing the radiation dose level or the irradiation time, but was decreased when the dose level was increased while holding the integral dose constant. The copolymerization rate under various conditions was evidence of a radical mechanism and a bimolecular breaking off of chains. (KSW)

2367 DECOLORATION OF TEXTILE DYE WASTE SOLUTIONS BY COMBINED IRRADIATION AND CHEMICAL OXIDATION. Craft, T. F.; Eichholz, G. G. (Georgia Inst. of Tech., Atlanta). Nucl. Technol.; 18: No. 1, 46-54(Apr 1973).

The effects of a combined radiation-oxidation process on solutions of textile dyes were studied. It was found that the combined treatment with γ radiation and chlorine causes more decoloration than the effect of the two components when they are applied individually. Several chemical classes of dyes were tested, including anthraquinone, azo, metallized-azo, sulfur, stilbene, and triphenylmethane dyes. At a concentration of 0.25 g/liter the transmittance at the wavelength of maximum absorbance of dye solutions is greatly increased by treatment with a radiation dose of 60 krad with 75-ppM chlorine added. Preliminary cost estimates indicate $0.31/1000 gal for such treatment, with normal operating costs potentially lower. (auth)

2368 RADIOACTIVE FLUID BED REACTOR SYSTEM FOR THE BETA-INITIATED SIDE CHAIN CHLORINATION OF TOLUENE. Ives, B. F. (State Univ. of New York, Buffalo); Cullinan, H. T. Jr.; Yang, J. Y. Nucl. Technol.; 18: No. 1, 29-45(Apr 1973).

A theoretical and experimental investigation of a radioactive fluidized bed chemical reactor is described. The fluidized particles are composed of radio-strontium silicate. The chemical system is the conversion of toluene to benzotrichloride. Experimental work defines the variables affecting bed porosity versus throughput at high bed expansions where significant radiation deposition could be achieved. Homogeneous fluidization is achieved by developing a classification technique to obtain a batch of radioactive microspheres with a narrow size and density distribution. Experimental data obtained with a semi-batch reactor using beta rays from a Van de Graaff generator led to the conclusion that the reaction proceeds according to 1½-order kinetics. The axial-dispersed plug flow model for three consecutive reactions and 1½-order kinetics results in four simultaneous nonlinear second-order ordinary differential equations. These equations with the appropriate boundary conditions are solved numerically using a finite difference technique. An economically optimum reactor design utilizing recycle is presented for the last part of the plant. (auth)

2369 CHEMICAL EFFECTS OF DIRECT AND INDIRECT INTERACTIONS OF X-RADIATION WITH IODINE CONTAINING AMINO ACIDS. Stelter, L. H. Toledo; Univ. of Toledo (1972). 115p. University Microfilms Order No. 73-5949. Thesis (Ph.D.).

Polycrystalline samples of di-, tri-, and tetraiodo-D,L-thyronine (T_2, T_3, T_4) were irradiated at room temperature with x-rays of 5 to 50 keV photon energy. Under these conditions, absorption takes place primarily in the iodine atoms of the molecules where electron vacancies are created in the K- and L-shells. Readjustment to these vacancies leads to ejection of further electrons and acquisition by the atoms of a high positive charge (Auger effect). Attempts were made to study the chemical consequences of this effect by product analysis after dissolution of the irradiated samples. Dose effect curves show that the radiation sensitivity of the compounds increases with decreasing number of iodine atoms per molecular; $G(-T_4) = 3.7 \pm 0.3$, $G(-T_3) = 5.1 \pm 0.4$ and $G(-T_2) = 11 \pm 1$. The relatively large difference between T_3 and T_2 may be associated with a discontinuous change in the crystal structure of these compounds. Mono- and diiodo-L-tyrosine (MIT, DIT) and the hydroiodide of L-tyrosine (TYR·HI) were irradiated under the same conditions as the thyronine derivatives. The dose effect curves show the same trend; G(-MIT) = 4.0 ± 0.2, G(-DIT) = 2.4 ± 0.1. Studies were also made on the reactivity of the hydrated electron with MIT in dilute aqueous solution. With formate as a scavenger for H· and OH·, the substrate is converted by interaction with the carboxylate radical formed from the scavenger. The reaction follows a chain mechanism. The rate constant $k(CO_2^- + MIT)$ was determined using two different approaches, to be $1.3 (\pm 0.1) \times 10^8$ M^{-1} sec^{-1}, for pH = 3.0. In competition experiments with ethanol as a scavenger the rate constant for the reaction of the hydrated electron with MIT was found to be $8.4 (\pm 0.5) \times 10^8$ M^{-1} sec^{-1}, for pH = 3.0 to 6.0, based on $K(e_{aq}^- + H_3O^+) = 2.36 \times 10^{10}$ M^{-1} sec^{-1}. The radiolysis products in the presence of either formate or ethanol as scavengers are tyrosine and iodide. Since these species are also formed in polycrystalline MIT, it can be assumed that in the latter system a fraction of these products is formed by thermalized electrons. (DHM)

2370 ELECTRON SPIN RESONANCE INVESTIGATION OF THE DISAPPEARANCE OF TRAPPED HYDROGEN ATOMS IN γ-IRRADIATED SULFURIC ACID GLASSES. Sprague, E. D.; Schulte-Frohlinde, D. (Max-Planck-Institut fuer Kohlenforschung, Mulheim an der Ruhr, Ger.). J. Phys. Chem.; 77: No. 10, 1222-1225(10 May 1973).

ESR measurements of the decay at low temperatures of hydrogen atoms produced by γ irradiation of 6 M H_2SO_4 glasses, with and without small concentrations of added 2-propanol, are reported. An analysis of the satellite lines present in the spectrum shows that the environment of the hydrogen atoms changes during the course of the reaction, and it is also observed that the saturation behavior is altered. The kinetic behavior is interpreted as a redistribution of the hydrogen atoms into deeper and deeper traps, in competition with irreversible decay reactions with other hydrogen atoms, 2-propanol molecules, or other reactive species present in the matrix. It is shown that these results are not adequately explained in terms of the presently existing theory of diffusion-controlled reactions. (auth)

2371 PULSE RADIOLYTIC STUDY OF THE SITE OF OH· RADICAL ATTACK ON ALIPHATIC ALCOHOLS IN AQUEOUS SOLUTION. Asmus, K. K.; Moeckel, H.; Henglein, A. (Hahn-Meitner Institut fuer Kernforschung, Berlin). J. Phys. Chem.; 77: No. 10, 1218-1221(10 May 1973).

The formation of reducing and oxidizing radicals was investigated in the reaction of hydroxyl radicals with formate, alcohols, and diols in pulse-irradiated aqueous solutions. Reducing radicals (CO_2^- and α-alcohol radicals) were identified by their reaction with tetranitromethane, oxidizing alkoxy radicals by their reaction with iodide. The reaction of hydroxyl radicals with formate and ethylene glycol exclusively leads to a radical with reducing properties. The principal reducing radical from methanol, CH_2OH, is formed from only 93% of the reacting hydroxyl radicals. The remaining 7% are accounted for by methoxy radicals formed in the reaction $OH· + CH_3OH \rightarrow H_2O + CH_3O·$. Relative probabilities for hydrogen atom abstraction from the α position, from the OH group, and from other positions of alcohols and diols by OH radicals are derived from the experimental data. (auth)

2372 PULSE RADIOLYTIC POLAROGRAPHY: ADSORPTION EFFECTS IN THE ELECTRODE KINETICS OF SHORT-LIVED FREE RADICALS. Henglein, A.; Graetzel, M. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Ber. Bunsenges. Phys. Chem.; 77: No. 1, 17-20(1973).

Mathematical solutions for the polarographic current as a function of time are given for the case of two-step electrode reactions: $R \rightarrow R_{(a)} \rightarrow P$ (R: radical produced by a pulse of electrons; $R_{(a)}$: radical adsorbed at the electrode; P: product of oxidation or

reduction). If R is long-lived or disappears according to first order kinetics, the differential equations involved are amenable to solution. If R disappears by second order kinetics, an explicit solution cannot be given; the solution for first order disappearance, however, may well be applied to such cases at times shorter than the first half-life time of the radical. The current-time curves exhibit a maximum whose magnitude and position with respect to time can be expressed in terms of the ratio $V = k/k_1$ where k is the transfer rate constant in s^{-1} and k_1 the time constant of the disappearance of the radicals in the solution. k is obtained at different electrode potentials. The transfer coefficient for the oxidation of the ethanol radical at pH = 6 is 0.37. (GF)

2373 REINFORCEMENT OF ORIENTED POLYETHYLENE WITH GRAFT POLYACRYLONITRILE. Kurilenko, A. I.; Krul, L. P. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk SSSR; 207: No. 2, 401-404(11 Nov 1972). (In Russian).

The influence of graft polyacrylonitrile (PAN) on the mechanical properties of polyethylene was investigated in the temperature interval between –196 and +300°C which encompassed all states of the polymer. The grafting was achieved by γ-irradiation of the polyethylene film carrying sorbed acrylonitrile monomer in a vacuum. The polyethylene was oriented by stretching at 20° or 95°C before and after grafting. A reinforcing effect of the PAN graft on the oriented film was observed. (KSW)

2374 PROCESS FOR THE PREPARATION OF TERTIARY PHOSPHINE OXIDES USING HIGH ENERGY RADIATION. Kleiner, H. J.; Rossinger, S. (to Farbwerke Hoechst, AG). U. S. Patent 3,714,009. 30 Jan 1973. Priority date 13 Mar 1969, Federal Republic of Germany (F. R. Germany). 6p.

An improved process for the preparation of tertiary phosphine oxides by reacting dialkyl phosphine oxides with α-olefins in the presence of high-energy radiation is described. In comparison with known processes the tertiary phosphine oxides are obtained according to the instant process within a shorter reaction time, with higher purity and with higher yields. The reaction products can be used as intermediates, surfactants, detergents and cleaning agents, especially in cosmetic products. (auth)

2375 STUDY OF γ-IRRADIATED POLYOLES IN THE 77 TO 350°K RANGE BY THE ESR METHOD. Nikitin, I. V.; Miroshnichenko, I. V.; Kudryashov, L. I.; Dyatkina, M. E.; Kochetkov, N. K. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 2, 356-358(11 Nov 1972). (In Russian).

A study was made of the primary radiolysis product radicals which were formed during the irradiation at 77°K of ribitol and mannitol. EPR spectra were taken of the irradiated samples over the temperature range 77 to 350°K, and the various doublet and triplet signals were assigned meanings in terms of the various bonds present. (KSW)

2376 GAMMA-RADIATION-INDUCED CROSSLINKING OF POLYETHYLENE. Mitsui, H.; Hosoi, F. (Japan Atomic Energy Research Inst., Takasaki). Polym. J.; 4: No. 1, 79-86(Jan 1973).

The γ-radiation-induced cross-linking of polyethylene was studied in vacuo at 30 to 200°C with a dose rate of 1.1×10^5 rad/hr. The gel fraction increased with rising irradiation temperature, and became almost constant above 150°C. The degree of increase was extremely large at near the melting temperature of polyethylene. The dosage to produce gelation decreased with the temperature, but was almost constant above 150°C. The gel fraction was increased by irradiation beyond the gel-point dosage at each temperature, and the relative increment decreased with the radiation dose. The amount of hydrogen formation was found to increase to some extent with temperature. The content of trans-vinylene unsaturation increased almost linearly with the dose, and the extent of the increment was little affected by the temperature. At 150 and 200°C, the methyl-group content also increased almost linearly with the dose, and the rate of increase was somewhat higher at 200°C than at 150°C. On the basis of these results, the mechanism of the γ-radiation-induced cross-linking of polyethylene was discussed. (auth)

2377 INHIBITORS FOR AQUEOUS PHASE, RADIATION POLYMERIZATION. Takehisa, M.; Senrui, S. (to Japan Atomic Energy Research Inst.). U. S. Patent 3,714,008. 30 Jan 1973. Filed date 12 May 1970. 6p.

In the polymerization, in which an aqueous phase is employed, of ethylene, or ethylene and other unsubstituted or substituted olefinic monomers by means of an ionizing radiation, formation of an undesirable polymer in the aqueous phase of the reaction system is inhibited by using specific polymerization inhibitors. The inhibitors which have no adverse effect on the polymerization in the non-aqueous phase, comprise the electrolytes which have strong oxidizing action and/or react at high reaction rate with active species such as H radicals, OH radicals and/or hydrated electrons formed by ionizing radiation. Adhesion of undesirable polymer to the reactor walls during polymerization reaction is prevented and contamination which lowers the quality of the main polymer is eliminated. (auth)

2378 RADIATSIONNAYA KHIMIYA GALOGENSODERZHASHCHIKH ORGANICHESKIKH SOEDINENII. (Radiation Chemistry of Halogen-Containing Compounds). Dzhagatspanyan, R. V.; Filippov, M. T. Moscow; Atomizdat (1973). 272p.

The radiolysis of halogen-organic compounds, the radioinduced chlorination and sulfo-chlorination of organic compounds, the telomerization of olefins with halogen-containing compounds, the hydrobromination of ethylene, and a number of other radiation processes constitute the subject of this monograph. The sources of the radiation used generally fall into two types: γ-radiation from either ^{60}Co or ^{137}Cs, or fast electrons. Reaction mechanisms and radiation yields of the many reactions discussed occupy considerable space. (227 references) (KSW)

2379 ESR STUDIES OF IRRADIATED FUSED QUARTZ AND POROUS VYCOR GLASS WITH AND WITHOUT PARTIAL MONOLAYERS OF METALS OR FERROCENE. Vanderspurt, T. H. Princeton, NJ; Princeton Univ. (1972). 168p. University Microfilms Order No. 73-9655.

Thesis (Ph. D.).

Hydrogen gas, dissolved in fused quartz, was converted to hydrogen atoms at 77°K by light between 2000 Å and 2900 Å. These hydrogen atoms dissappeared below 156°K with the resultant formation of oxysilicon hydride, free hydride ions, positive hydrogen species and trapped electrons, E′ centers. These centers were stable to about 373°K. Reirradiation at 77°K, before warming above 300°K, with light from 2000 Å to 7000 Å resulted in hydrogen atom formation. Gamma irradiation of fused quartz at 77°K resulted primarily in the formation of trapped hydrogen atoms and holes trapped in the Si–O network. Warming to 293°K resulted in the disappearance of the hydrogen atom and hole signals and the appearance of a strong asymmetric signal at g = 2.0005 due to E′ centers. Reirradiation at 77°K resulted in the reappearance of the hydrogen atom signals and the appearance of a modified signal due to trapped holes. The signal due to trapped electrons decreased. The ultraviolet irradiation at 77°K of carefully cleaned acid leached porous Vycor glass, PVG, did not result in any detectable ESR signals. This did result in phosphorescence in the ultraviolet for up to 12 hours at 77°K. When PVG was treated with hydrogen gas at 800 torr from 273°K to 873°K, and irradiated at 77°K with light in the 2250 to 2900 Å region, hydrogen atoms were formed. The presence of partial monolayers of Ru, Rh, Pd, Ir or Pt had no markedly significant effect on the production of hydrogen atoms while, to some extent, Re did. Gamma irradiation of PVG with high hydroxyl content resulted in the occurrence of strong hydrogen atom signals with forbidden transitions at 77°K. A strong signal, due to the hydroperoxyl radical, was also evident. PVG, with low hydroxyl concentration, gave weaker hydrogen signals, unless treated with hydrogen gas. No forbidden transitions were detected and the central signal resembled that previously reported for gamma irradiated silica-aluminas. It was found that deuterium atoms may be displaced from partial monolayers of Pd by carbon monoxide at 77°K and trapped in the PVG matrix, while a similar effect was found for Re–Pt with ethylene. Ferrocene on PVG gave essentially the same ESR signal after gamma irradiation, as did PVG alone. On ultraviolet irradiation, at 77°K, it gave spectra due to the cyclopentadienyl radical, hydrogen atoms and possibly the cyclobutadienyl radical anion. A resonance, due to ferrocenium-superoxide, was detected when ferrocene, on PVG, was exposed to oxygen at 25°C in the dark. (Diss. Abstr. Int., B)

2380 TRAPPED FREE RADICALS AND ELECTRONS IN ORGANIC GLASSES. Willard, J. E. (Univ. of Wisconsin, Madison). Contract AT(11-1)-1715. Science; 180: No. 4086, 553-561(11 May 1973).

The current knowledge of the trapping of radicals, hydrogen atoms, and electrons produced in organic glasses by radiolysis and photolysis is surveyed. Results in the field provide information on the spectra, identity, spatial distribution, and reaction kinetics of the trapped species and reveal previously unsuspected properties of the matrices, such as the ability of glassy hydrocarbons to trap electrons and positive charge. (DHM)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 2579.

2381 REVISED CHART FOR THE ESTIMATION OF RADIOACTIVITY DUE TO THERMAL NEUTRON IRRADIATION. Okada, M. (Japan Atomic Energy Research Inst., Tokai). J. Radioanal. Chem.; 12: No. 2, 557-562(Dec 1972).

Charts are presented for the rapid determination of the radioactivity of samples exposed to a thermal neutron flux. Through the use of new cross-section information, data for 249 reactions are included. Since the report on the rapid method is in Japanese, a sample calculation is presented in English. (auth)

Hot-Atom Chemistry

2382 (AEC-tr-7424) REACTIONS OF FISSION RECOIL ATOMS, PARTICULARLY OF IODINE, WITH METHANE AND OTHER GASES. Denschlag, J. O. (Mainz Univ. (West Germany)). 1965. Translation of a German thesis. 157p. Dep. NTIS $10.00

It was proved that methyl iodide and methyl bromide develop when fission recoil atoms act upon methane. In case of action upon ethane, it was possible to prove the presence of methyl iodide, methyl bromide, ethyl iodide, and vinyl iodide. In each case, methyl iodide is the main reaction product (more than 60%). The compounds are volatile at room temperature and remain in the gas chamber over a longer interval of time (at least several hours). Elementary iodine and hydrogen iodide likewise seem to develop here although they are precipitated upon the vessel walls within a matter of seconds. This is why almost only organically-bound iodine could be established in the gas chamber a few minutes after the end of irradiation. It was possible to identify three reaction paths leading to methyl iodide: (a) a prompt reaction of the fission recoil atoms of primary iodine; (b) a fast reaction of the beta-recoil atoms of the secondary iodine; (c) a delayed reaction of the iodine which did not react according to (a) or (b) and which was fixed on the vessel walls; it can be described as a first-order reaction and it can be characterized by a half-life period. (auth)

2383 RAPID SEPARATION OF FISSION HALOGENS BY RECOIL REACTIONS WITH METHANE. Kratz, K. L.; Herrmann, G. (Univ., Mainz). Radiochem. Radioanal. Lett.; 13: No. 5-6, 385-390(30 Apr 1973).

The formation of volatile methylhalides through recoil reactions with methane is used in a separation procedure for bromine and iodine from fission products which can be performed within 0.5 sec. (auth)

2384 BEHAVIOR OF RADIOACTIVE ANTIMONY AND TELLURIUM FORMED BY HIGH-ENERGY PROTON IRRADIATION OF CESIUM SALTS CONTAINING OXYGEN. Dema, I. (Inst. for Atomic Physics, Bucharest); Zaitseva, N. G. Rev. Roum. Phys.; 17: No. 4, 443-447(1972).

In solid cesium carbonate, nitrate, sulfate, chromate, and citrate irradiated with 660-MeV protons, the anion of the target has a marked influence on the radioantimony and radiotellurium distribution between their higher and lower valency states. The thermal annealing of these salts at 100 and 200°C suggests competitive reactions oxidizing and reducing in character. A comparison of the behavior of Sb and Te recoils and that of radioiodine formed in the same targets by high-energy proton bombardments was made. The thermal annealing at 100°C of radiotellurium from high-energy proton-irradiated telluric acid was also investigated. (auth)

2385 RADIOCHEMISTRY. Volume I. A Review of the Literature Published Between July 1969 and August 1971. Newton, G. W. A.; Gilmore, G. R.; Hemingway, J. D. Specialist Periodical Report. London; Chemical Society (1972). 131p.

The review covers the areas of solid state recoil chemistry, the radiochemistry of elements with Z > 103, and radiochemical methods of analyses, for the period July 1969 to July 1971. Section headings include: chemical effects of nuclear transformations (physical methods used to study recoil chemistry, p-block elements, d-block elements, ^{32}P and ^{35}S recoils, recoil phenomena in solution, chemical effects following beta decay, annealing of recoil atoms in solids); superheavy elements (predicted properties, methods of synthesis, results of attempts at preparation, natural occurrence of superheavy elements); radiochemical methods of analysis (tracer methods-isotope dilution, radioisotope exchange, radiorelease, radiometric titration; activation analysis; chemical separations in radiochemical analysis). (UK)

2386 RECOIL TRITIUM REACTIONS WITH CYCLOBUTANONE. A Test for Electronically Excited Products of the T-for-H Substitution Reaction. Izawa, G.; Lee, E. K. C.; Rowland, F. S. (Univ. of California, Irvine). J. Phys. Chem.; 77: No. 10, 1210-1217(10 May 1973).

The possibility of the formation of electronically excited molecules in hot atom reactions was evaluated for T-for-H substitution reactions with gas-phase cyclobutanone ($c\text{-}C_3H_6CO$). Measurements of relative yields vs pressure show that highly excited $c\text{-}C_3H_5TCO^*$ molecules decompose by two separate mechanistic pathways, with the formation either of C_2H_3T plus CH_2CO or of $c\text{-}C_2H_5T^*$ plus CO. The yields of tritiated C_3 products are slightly larger than anticipated from the energetic decomposition or vibrationally excited ground state $c\text{-}C_3H_5TCO$, and an upper limit of 10% has been estimated for the fraction of $c\text{-}C_3H_5TCO$ formed in any of the excited electronic states. The median vibrational energy is estimated to be 3 to 4 eV, somewhat less than the 5 eV estimated for T-for-H substitution reactions with $c\text{-}C_4H_8$. The chief other products from hot T* reactions with $c\text{-}C_3H_6CO$ are HT and several radicals originating with ring-opening attack of T* on the ring C-C bonds. The ratio of $HT/c\text{-}C_3H_5TCO$ is ~1.8 for cyclobutanone, leading to an estimate of ~95 kcal/mol for the average C-H bond dissociation energy in $c\text{-}C_3H_6CO$. (auth)

2387 HOT-ATOM CHEMISTRY OF ^{208}Tl RECOIL ATOMS. Ackerhalt, R.; Ellerbe, P.; Harbottle, G. (Brookhaven National Lab., Upton, NY). Radiochim. Acta; 18: No. 2, 73-80(1972).

Carrier-free "active deposits" from thoron were used as sources of energetic ^{208}Tl recoil atoms. The hot atom chemistry of the implanted thallium atoms was observed in a number of targets, with particular attention to monocrystalline NaCl and KCl plates. The results suggest that traces of impurities such as water are having a marked effect on the valence finally assumed by the thallium atoms. (auth)

2388 RAPID RADIOCHEMICAL SEPARATION BY ELECTROLYTIC DISSOLUTION. Weber, M.; Stelter, A.; Herrmann, G. (Univ., Mainz). Radiochim. Acta; 18: No. 2, 80-86(1972). (In German).

The release into aqueous solutions of 3.1 min ^{208}Tl originating from its precursor 60 min ^{212}Bi deposited on a platinum cathode was studied. It is shown that the release occurs within a few seconds even for layers several mg/cm^2 thick. In the mechanism the α-recoil plays an important role. It causes on one side that 50% of the ^{208}Tl cannot be released, on the other side it overcomes an adsorption of small amounts of thallium that depends on the electrical potential of the cathode. In consequence large differences result in the behavior of ^{208}Tl as compared to thallium not formed in a recoil reaction. Application of this technique for the study of short-lived nuclides and of electrochemical processes are discussed. (auth)

2389 REACTION OF ENERGETIC TRITIUM ATOMS WITH BROMINE. Malcolme-Lawes, D. J. (Univ. of Kent, Canterbury, Eng.). Radiochim. Acta; 18: No. 2, 111-112(1972).

The energy transfer model was applied to the hot reaction $T + Br_2 \rightarrow TBr + Br$ by making a hard-sphere approximation for the collision process. The excitation function was derived for the reaction. The total cross section for all processes was found to be ~12.05 $Å^2$ (energy independent as a result of the hard-sphere approximation). The derived excitation function indicates that tritium reacts efficiently with bromine above thermal energies up to ~2.5 eV. (DHM)

2390 LOCALIZATION OF THE RADIOACTIVE BROMINE ATOM IN 1,2 DIBROMOBUTANE FORMED IN NEUTRON IRRADIATED n-BUTYL BROMIDE. Ronneau, C.; Guelluy, F.; Cara, J.; Apers, D.; Capron, P. (Univ., Louvain, Belgium). Radiochim. Acta; 18: No. 2, 101-103(1972).

The localization of the radioactive bromine atom fixed in 1,2-dibromobutane as a consequence of thermal neutron irradiation of n-butyl bromide was studied by means of a dehydrobromation method. The radioactive bromine appears to become attached almost statistically to the first and to the second carbon atom of the butyl chain, whatever experimental conditions are. (auth)

Properties of Radioactive Materials

Refer also to abstracts 2185, 2252, and 2315.

2391 (BNL-17682) SYNTHESIS OF RADIOPHARMACEUTICALS AND LABELED COMPOUNDS UTILIZING SHORT-LIVED ISOTOPES. Wolf, A. P.; Christman, D. R.; Fowler, J. S.; Lambrecht, R. M. (Brookhaven National Lab., Upton, N. Y.). 1972. 115p. (CONF-730309-7). Dep. NTIS $7.75.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

Labeled organic compound preparation in the context of use in the practice of nuclear medicine is reviewed. Accelerator produced nuclides and radiopharmaceutical production are discussed with examples of pertinent methods of isotope production, methods of incorporation into organic molecules, and the general problems attendant to the production and use of these materials in this new

and interdisciplinary effort. The literature is surveyed with stress being given to the utilization of carbon-11, fluorine-18, iodine-123, nitrogen-13, and oxygen-15. An extensive bibliography of accelerator and generator produced nuclides is appended covering methods of nuclide preparation, incorporation and use in nuclear medicine and related applications. (1269 references) (auth)

2392 (CEA-R-4417) DETERMINATION OF THE PHYSICO-CHEMICAL STATE OF RADIONUCLIDES AND LABELLED COMPOUNDS IN SOLUTION IN BIOLOGICAL FLUIDS: Fe, Ce, Np, AND CALCITONINE BY CURRENT FLOW ELECTROPHORESIS. Masse, R.; Jovanovic, V.; Fragu, P.; L'Hullier, L.; Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 22p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

The constituents of a mixture can be punctually separated as a function of their electrokinetic potential by continuous current flow electrophoresis. The constituent mobility is characterized by an angular value, which allows to minimize adsorption artefacts on the migration carrier. Current flow electrophoresis thus appears as an excellent analytical method for the demonstration of labile molecular associations. (auth)

2393 (CNEA-325) INFLUENCE OF THE PROPERTIES OF ^{131}I PREPARATIONS ON THE LABELING OF POLYPEPTIDES BY MEANS OF THE CHLORAMINE-T METHOD. Kurcbart, H.; Quiroga, S.; Caro, R. A.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 15p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Studies are described which were carried out in order to establish the optimal conditions for the utilization of $Na^{131}I$ preparations when they are used for the labeling of polypeptides by means of the Chloramine-T method. It was found that the chemical and the radiochemical purities of the $Na^{131}I$, as well as the amount of the inactive iodide, play an important role in the yield and in the reproducibility of the process. (auth)

2394 (CNEA-327) HEAT CONTROL IN COMPOUNDS MARKED WITH ^{99m}Tc. de Castiglia, S. G.; Cembal, S. J.; Fraga de Suarez, A. H.; Nicolini, J. O.; Noto, M. G.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Control of radiochemical purity and pharmacological conditions such as osmotic pressure, pH and particle sizes of technetium compounds are described. Sterility, toxicity and pyrogen test were also performed. The ^{99m}Tc used in the labeling procedures was obtained: from Mo–Tc commercially available generators and by methyl ethyl ketone (MEK) extraction from alkaline solution of molibdene. The MEK concentration that could remain in the Tc solution was determined in order to evaluate the biological hazards. A method to evaluate the MEK concentration in the pertechnetate solution is described. (auth)

2395 (SRARI-P-158) SOME REGULARITIES IN COMPLEXING TRIVALENT IONS OF AMERICIUM, CURIUM, AND PROMETHIUM WITH PHOSPHORUS- AND CARBOXYL-CARRYING LIGANDS. Elesin, A. A.; Zaitsev, A. A. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Based on reported data, the regularities in complexing americium, curium, and promethium with a number of phosphorus- and carboxyl-carrying ligands were considered. Correlations are established and observed deviations are explained. (auth)

2396 (UJV-2866-CH) HYDROTHERMAL REDUCTION OF URANIUM TRIOXIDE. Urbanec, Z. (Ceskoslovenska Akademie Ved. Rez. Ustav Jaderneho Vyzkumu). Jan 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

A two-staged hydrothermal reduction of $UO_3 \cdot H_2O$ in the presence of ethanol was studied. $UO_3 \cdot H_2O$ reduces first to a compound of an approximate composition of $UO_{2.5}$. The compound has an orthorhombic symmetry similar to $\alpha-U_3O_8$, but its infrared spectrum was found to be more complicated than the latter phase. The most probable explanation of the first-stage compound is a phase described as $UO_{2.6}$ or U_5O_{13}. In the second reduction stage, UO_2 is formed. The effects of temperature, concentration of ethanol, and reaction time are described. (auth)

2397 APPLICATION OF FIRST ORDER KINETIC EQUATION FOR THE EVALUATION OF KINETIC PARAMETERS BY DTA—URANYL OXALATE TRIHYDRATE SYSTEM. Subramanian, K. S.; Radhakrishnan, T. P.; Sundaram, A. K. (Bhabha Atomic Research Centre, Bombay). Curr. Sci. (India); 42: No. 7, 235-236(5 Apr 1973).

The activation energy calculated for the first step of dehydration of uranyl oxalate trihydrate at heating rates of 6, 12, and 18°C/min were calculated to be 22 ± 2, 21 ± 1, and 22 ± 1, respectively. (DHM)

2398 PRINCIPLES OF RADIOACTIVE TRACER TECHNIQUES IN INDUSTRY. Fries, B. A. (Chevron Research Co., Richmond, CA). Proc. Jap. Conf. Radioisotop.; No. 10, 203-210 (Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

As the guiding principles of radioactive tracer techniques for industrial works, simple procedures and simple equipment should be used to obtain informative results of economic value to industry. Applications involving continuous addition of radioisotopes as tracers in industrial processes have not been widely developed, while the radiotracers have been used extensively for investigative or trouble-shooting purposes to solve problems in process industries; but for the solution of problems, only limited time and limited funds are available. The radiotracer application must always contend with conventional methods, and somewhat hazardous material must be handled. These factors affect acceptability of the application. Technical feasibility, safety, and economical feasibility must be approved before the application. The tracer techniques must offer some advantage in providing information, they are cheaper or are not appreciably more costly, and must be applied promptly when requested. Gauging with portable radioisotope sources is not the tracer application, but the gauging of catalyst level in petroleum refining reactors, level of ion exchange resin in water-treating vessels, and others is very important in the industries concerned. A leak in a vertical four-path heat exchanger was determined quantitatively with ^{134}Cs tracer. Environmental pollution due to NO_2 gas from a nitric acid plant was investigated with ^{85}Kr tracer. Measurement of the flow rate of SO_2 gas was carried out with ^{85}Kr tracer in a sulfur-recovery plant. The flow rate of the mixture of steam and natural gas was measured with ^{85}Kr tracer for the natural gas and ^{3}H tracer for the steam in a hydrogen-manufacturing plant. (Japan)

2399 PROBLEMS IN TRACER APPLICATIONS. Kobayashi, M. (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 264-266(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Survey and investigation with radioisotope tracers are more and more specialized, together with the advance of techniques. In routine and standardized works with tracers, a measuring method is first described with emphasis on the problem of error. Determination of the mercury content in the production of Cl_2 gas by the electrolysis of NaCl and activation analysis of mercury in human hair are taken as examples. An agricultural chemical attached to rice plants was investigated with an activable tracer Eu contained in the chemical, and the voluminous data thus obtained were rapidly processed with a computer. Utilization of "response functions" is then useful in tracing flow pattern in complex system. Radioisotope generators such as Mo–Tc and Sn–In are convenient in medicine and other fields. Finally, the radio-release technique and isotope ratio measurement are used for the survey of the environmental pollution problem in the U. S. A., and stainless steel capsules are used as tracer containers in pulp manufacturing in Japan. (Japan)

2400 URANYL SULPHATE COMPLEXES WITH SOME PYRIDINE N-OXIDES. Ahuja, I. S.; Singh, R. (Banaras Hindu Univ., India). Inorg. Nucl. Chem. Lett.; 9: No. 5, 545-550(May 1973).

A study is described on the preparation and ir spectral features of the coordination compounds formed by UO_2SO_4 with pyridine N-oxide and its derivatives, with a view to elucidating the nature of the sulphate bonding and structure of these complexes. It was found that UO_2SO_4 forms 1:2 complexes with pyridine N-oxide and with 2-methyl, 3-methyl, 4-methyl, 2:6 dimethyl and 4-cyano pyridine N-oxides. Analytical data and characteristic infrared frequencies, together with intensities, are summarised in tabular form, and discussed. Infrared spectra of practically all the complexes showed the presence of coordinated sulphate groups, and the frequencies of absorption bands due to sulphate groups were consistent with those normally associated with bidentate chelating sulphate groups. It is suggested that the complexes have six-coordinated U with four ligand atoms (two O's of the monodentate pyridine N-oxide molecules and two O's of the bidentate chelating sulphate group), forming an equatorial ring around the linear UO_2-group. The data suggested that the metal-ligand bonding is quite strong. The complexes were obtained by mixing the sulphate and ligand solutions in methanol. (UK)

2401 AMERICIUM MONOARSENIDE. Charvillat, J. P.; Damien, D. (CEN, Fontenay-aux-Roses, France). Inorg. Nucl. Chem. Lett.; 9: No. 5, 559-563(May 1973).

Details are given of the preparation and crystal structure of AmAs. The arsenide was prepared on a 50 mg scale of vapour phase reaction of excess As on ^{241}Am hydride in a pyrex tube sealed under high vacuum and heated for a week at 330°C. The

only arsenide obtained was the monoarsenide. The X-ray diffraction pattern of samples so obtained indicated two phases—a metallic arsenic phase and a cubic NaCl type phase that was labelled AmAs by analogy with the corresponding Pu and Np monoarsenide. A single AmAs phase was, however, obtained after heating the mixture at 33°C under high vacuum to eliminate the excess As. The lattice parameter was found to be a = 5.8753 ± 0.0002 Å and x-ray data are shown tabulated. Lattice parameters are compared for the Th, As, UAs, NpSa, PuAs, and AmAs. An increase of lattice parameter was observed from U to Am. Comparisons are made with the rare earth monoarsenides. (UK)

2402 RAPID RELEASE OF VOLATILE FISSION PRODUCTS FROM SOLID URANIUM TETRAFLUORIDE. Weber, M.; Trautmann, N.; Menke, H; Herrmann, G.; Kaffrell, N. (Univ., Mainz). Inorg. Nucl. Chem. Lett.; 9: No. 5, 519-525(May 1973).

Rapid volatilisation from solid targets is stated to be a powerful technique for the study of short-lived nuclides produced in complex nuclear reactions. In most of the applications reported the direct formation of volatile elements has been studied, and little has been reported on volatile compounds formed in a solid matrix. In the present work neutron irradiated UF_4 was chosen for study since a large number of elements present in fission product mixtures form fluorides and oxyfluorides of low boiling or sublimation point, and various aspects of the volatilisation process and the deposition of volatilised species could be studied for a variety of elements. The crucial condition for the application of such techniques to short-lived nuclides is a rapid over-all time scale for the escape of volatile species from the solid target. It was demonstrated that rapid release could be achieved; a half-time of about 20 sec was found for the volatilisation of Te from UF_4 at 800°C, and using improved techniques for on-line γ-ray spectroscopy even shorter half-times were obtained for several elements. Experimental details are given, and data are given for the activities of ^{132}Te, ^{131}I, ^{133}Xe and ^{99m}Tc during volatilisation from UF_4 at 800°C in an Ar atmosphere. The different behavior of elements in such experiments is discussed. (UK)

2403 IMPROVED SYNTHESIS OF RADIOLABELLED ACETYLACETONE. Doorenbos, H. E.; Muelder, W. W.; Wass, M. N. (Dow Chemical Co., Midland, MI). J. Label. Compounds; 8: No. 4, 701-703(1972).

When radiolabelled acetylacetone is prepared by acetylation of acetone-2-^{14}C by the conventional method, only 16% of the radioactivity is present in the final product. The "inverse addition" (addition of the anhydride and ketone to the BF_3 complex) and "fast saturation" (rapid saturation of solvent with BF_3) procedures have been shown to improve the yields of β-diketones. However, the preparation of acetylacetone by this method has not been reported. Preliminary experiments indicated that the maximum chemical and radiochemical yields are obtained using the above "inverse addition" procedure with a ratio of two moles of acetic anhydride to one mole of acetone. A chemical yield of 79.01% and a radiochemical yield of 75.67% were thus obtained. (auth)

2404 INFRARED SPECTRA OF THE OH GROUPS ON THE SURFACES OF OXIDES. Platonov, V. V.; Tret'yakov, N. E.; Filimonov, V. N. Usp. Fotoniki; No. 3, 92-129(1972). (In Russian).

A review on the ir spectra of the OH groups on the surfaces of the oxides of Be, Mg, Ca, Zn, Y, Al, Ga, In, Ti, Zr, Hf, Th, Si, Ge, Ta and Ni is presented. Primary attention is given to the following problems: (1) detection and clarification of the specifics of the structure of the hydroxyl cover on the oxides; (2) conditions of removal of water adsorbed in molecular form from the surface and conditions of dehydroxylation of the surface; (3) interaction of OH groups with physically adsorbed molecules. (85 references) (JPRS)

2405 CATALYTIC PROPERTIES OF THORIUM OXIDE IN CARBON MONOXIDE OXIDATION. II. Forms of Adsorbed Oxygen and the Mechanism of Carbon Monoxide Oxidation over Thorium Oxide. Breysse, M.; Claudel, B.; Veron, J. (Inst. of Catalysts, Villeurbanne, France). Kinet. Katal.; 14: No. 1, 102-109(1973). (In Russian).

The chemisorption of oxygen on ThO_2 was investigated by conductometric and EPR measurements, and the aggregate of results conformed to the following mechanism: O_2 (gas) $\rightarrow$ O_2 (ads) $\xrightleftharpoons{e^-}$ O_2^- (ads) $\rightarrow$ O (ads) + O^- (ads) $\xrightleftharpoons{e^-}$ $2O^-$ (ads). The probable catalytically active forms were O and O^-. The role of charged and uncharged forms of CO and O are discussed. The surface reaction between CO and O (presumably in the atomic form) determined the rate for the overall oxidation process, but certain electron transitions which accompany the process must be considered. (KSW)

2406 MEASUREMENT OF THE REDOX POTENTIAL OF PLUTONIUM(VII)/(VI) COUPLE IN SODIUM HYDROXIDE SOLUTIONS. Ghosh Mazumdar, A. S.; Natarajan, P. R.; Vaidyanathan, S. (Bhabha Atomic Research Centre, Trombay, India). Radiochem. Radioanal. Lett.; 13: No. 5-6, 361-368(30 Apr 1973).

Plutonium(VII) being unstable in aqueous solutions, the usual static method of measuring the electrode potential is difficult to apply in the case of the Pu(VII)/Pu(VI) couple. The formal redox potential of this couple has therefore been measured by a dynamic method and is found to be 1.17 ± 0.02 V referred to a standard hydrogen electrode in 1.6 and 3.0 M NaOH solutions. The applicability of the method in the present case is discussed briefly. (auth)

2407 GAS PHASE TRANSPORT OF URANIUM FROM URANIUM DIOXIDE IN A FLOW OF ALUMINUM CHLORIDE VAPOR. Herczynska, E. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 13: No. 5-6, 301-305(30 Apr 1973).

Volatile compounds of uranium (chloride and/or complexes of uranium chlorides with Al_2Cl_6) were obtained from UO_2 in a flow of nitrogen and aluminum chloride vapors at 500°C under reduced pressure. (auth)

2408 ACTION OF ELEMENTARY FLUORINE ON THE HIGHER OXIDATION STATES OF PLUTONIUM AND NEPTUNIUM IN AQUEOUS ALKALINE SOLUTIONS. Peretrukhin, V. F.; Krot, N. N.; Gel'man, A. D. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 650-651(1972).

Translated from Radiokhimiya; 14: No. 4, 633-634(1972).

The effect of fluorine on solutions and suspensions of hepta- and hexavalent plutonium and neptunium in 0.5 to 12 M KOH and in 0.5 to 3 M NaOH with concentrations of the elements from 1×10^{-4} to 7×10^{-3} g-atom/liter was studied. It was concluded that the reduction of heptavalent plutonium to the tetravalent state in alkaline solution and the reduction of heptavalent neptunium to the pentavalent state by the action of fluorine was caused by the accumulation of hydrogen peroxide in solution. (DHM)

2409 COMPLEX FORMATION WITH DIETHYLENETRIAMINEPENTAACETIC ACID. VI. Americium(III). Piskunov, E. M.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 656-659(1972).

Translated from Radiokhimiya; 14: No. 4, 638-640(1972).

The complex formation in the system Am(III) – DTPA was studied by pH potentiometric titration and spectrophotometrically. The stability constant obtained for the complex AmA^{2-} was 22.10 ± 0.05 (in confidence limits at the 95% probability level). (DHM)

2410 EVIDENCE FOR THE EXISTENCE OF COLLOIDAL PRECIPITATES IN METAL CYANIDES BY RADIOMETRIC TITRATION. Malik, W. U.; Singh, B. P.; Jain, J. P. (Univ. of Roorkee, India). J. Radioanal. Chem.; 12: No. 2, 553-556 (Dec 1972).

A radiometric titration method was used to investigate the colloidal behavior of cobalt complexes of hexacyanoferrate(II), octacyanomolybdate(IV), and octacyanotungstate(IV). Confirmation that colloidal precipitates are obtained at points corresponding to kinks in the titration curves for cobalt hexacyanoferrate and cobalt octacyanomolybdate was obtained. The quite different appearance of the titration curve for cobalt octacyanotungstate indicates that the complex is dispersed in excess octacyanotungstate to give an almost soluble complex. (JGB)

2411 METHOD OF DETERMINING THE SORPTION OF MICROQUANTITIES OF RADIOACTIVE ISOTOPES IN THE REGION OF THEIR HYDROLYSIS. Shchebetkovskii, V. N. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 652-653(1972).

Translated from Radiokhimiya; 14: No. 4, 635-636(1972).

In order to demonstrate the absorption of the isotopes in the sorption system not only by walls of the vessels, but also by extraneous dust contaminants of the solution, an investigation was conducted with ^{91}Y. Results show that in neutral solutions in which hydrolysis of yttrium occurs, the absorption of the sorbate on the walls of the chemical vessels and contaminations is rather great, and it must be considered, especially in the case of a comparatively low content of the sorbent in the investigated system. (DHM)

2412 COMPLEX FORMATION IN DIETHYLENETRIAMINEPENTAACETIC ACID. VII. Curium(III). Piskunov, E. M.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 660-663(1972).

Translated from Radiokhimiya; 14: No. 4, 641-643(1972).

The complex formation of trivalent curium with DTPA was studied by the method of competitive complex formation in the

system Am(III) – Cm(III) – DTPA. The stability constant of the complex CmA^{2-} was found to be 22.85 ± 0.08 at 20°C and ionic strength μ = 0.5. (DHM)

2413 INFRARED ABSORPTION SPECTRA OF CERTAIN NEPTUNIUM(VII) COMPOUNDS. Tsivadze, A. Tu.; Krot, N. N. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 646-649(1972).

Translated from Radiokhimiya; 14: No. 4, 629-633(1972).

The ir absorption spectra (400–4000 cm^{-1}) of compounds of neptunium(VII) with the composition $[Co(NX_3)_6]NpO_5 \cdot 3X_2O$, $[Pt(NH_3)_5Cl]NpO_5 \cdot H_2O$, where X = H or D, as well as $Ba_3(NpO_5)_2 \cdot 3H_2O$ in the crystalline state, were studied. It was shown that part of the oxygen atoms in these compounds play the role of bridges, forming chains of NpO_6 octahedra with flat NpO_4 groups in the equatorial plane. (auth)

2414 KRYPTONIZATION OF HALIDES OF THE ALKALI AND ALKALINE EARTH METALS. Trofimov, A. M.; Gaiduk, G. I. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 618-621(1972).

Translated from Radiokhimiya; 14: No. 4, 604-608(1972).

The kryptonization of NaCl, NaBr, NaF, $CaCl_2$, CaF_2, $BaCl_2$, BaF_2 and ZnF_2 was investigated in the temperature interval from 200 to 500°C at a pressure of 30 atm. The stability of kryptonates at room temperature in an atmosphere of air was investigated. The most stable kryptonates of sodium halides lose no more than 5% of the absorbed activity of ^{85}Kr in 40 days. The density of kryptonization of the surface layers of halides was determined, arranging them in the following series: $BaCl_2$ > NaBr > NaCl > $CaCl_2$ > NaF > ZnF_2 > CaF_2 > BaF_2. A substantial influence on kryptonization of the interatomic distances and melting points of the halides was established. The temperature dependences of the activation energy of processes of kryptonization of halides were determined. A sharp increase in the activation energy (5-fold) was established for NaCl and NaBr at temperatures above 400°C. The depth of penetration of krypton into NaCl at 500°C and 30 atm was determined to be 1.4×10^4 Å. (auth)

2415 KRYPTONATES OF GRAPHITE. Troflimov, A. M.; Gaiduk, G. I. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 612-617(1972).

Translated from Radiokhimiya; 14: No. 4, 597-603(1972).

The absorption of krypton and xenon by powdered reactor graphite as a result of diffusion in the surface layer at temperatures from +450 to –20°C and pressures of 29 and 39.6 atm was investigated. Diffusion absorption of the noble gases by graphite was established in the entire investigated temperature interval with an exponential temperature dependence and a direct proportionality to the square root of the time. The maximum absorbed amount of krypton and xenon at the highest temperature (+450°C) and 2 h contact with the gas was 14 and 40 nmm^3/g, respectively. The stability of kryptonates and xenonates of graphite was characterized by the period of retention of half the diffusion-absorbed krypton or xenon when they were stored in room temperature air. For kryptonates this period is 80 days. The activation energies of the diffusion absorption of krypton and xenon by graphite, correspondingly equal to 4.5 and 4 kcal/mole, were determined. The diffusion coefficient of the dekryptonization of graphite at room temperature, $D = 9 \times 10^{-12}$ cm^2/sec, was calculated. (auth)

2416 POSITION OF THE TRANSACTINIUM ELEMENTS IN D. I. MENDELEEV'S PERIODIC SYSTEM. Lebedev, I. A. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 632-635(1972).

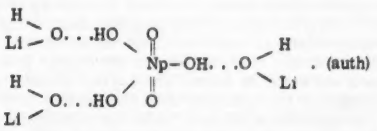
Translated from Radiokhimiya; 14: No. 4, 618-622(1972).

A periodic table of the elements is constructed based on the general rule that each period should contain as many rows and each vertical group as many subgroups as there are electron shells being filled in the elements of the period. Thorium, protactinium, uranium, and neptunium are placed in the second side subgroups of groups IV, V, VI, and VII, respectively. The "tetrad" of elements (Pu, Am, Cm, Bk) are placed in the second subgroup of group VIII. The following three elements (Cf, Es, and Fm) fall in the second side subgroup of group I. The elements Md and No are placed in the second side subgroup of group II. The second side subgroup of group III contains only lawrencium. Element 104 (kurchatovium) is situated in the first side subgroup of group IV, under hafnium. Since the structure of periods VI and VII should be entirely analogous, according to the concept outlined, the lanthanides (4f elements) are accommodated in the second side subgroups of groups I-VIII of the sixth period, like the 5f elements. Guided by the principle outlined, considerations on the structure of the hypothetical eighth period are expressed. (DHM)

2417 STRUCTURE OF COMPOUNDS OF NEPTUNIUM(VII). Chaikhorskii, A. A.; Zelentsov, S. S.; Leikina, E. V. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 636-640(1972).

Translated from Radiokhimiya; 14: No. 4, 622-625(1972).

It was shown by an investigation of the ir spectra of neptunium(VII) salts that the "green" complex is best characterized by the formula $NpO_2(OH)_6^{3-}$, corresponding to the structure $NpO_2(OH)_3(OH_2)_3$ or



2418 PRODUCTION OF HEPTAVALENT NEPTUNIUM BY THE OXIDATION OF NEPTUNIUM DIOXIDE IN ALKALINE MEDIUM. Shvedov, V. P.; Seregin, V. I. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 641-643(1972).

Translated from Radiokhimiya; 14: No. 4, 626-628(1972).

The possibility of the electrochemical oxidation of NpO_2 to Np(VII) in alkaline medium was established. It was found that preliminary oxidation of Np(IV) to Np(VI) by the action of $KBrO_3$ in sulfuric acid, followed by neutralization to an alkaline pH, leads to the production of solutions of heptavalent neptunium. (auth)

2419 INVESTIGATION OF THE ELECTROMIGRATION OF IONS IN MOLTEN SALTS USING RADIOACTIVE ISOTOPES. Ivanov, I. A.; Shvedov, V. P. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 622-626(1972).

Translated from Radiokhimiya; 14: No. 4, 608-613(1972).

The use of radioactive tracers permitted a disclosure of the influence of the size of the ions and properties of background melts in which the particles move on the electrotransport of ions. The results of an investigation of the electromigration of ^{22}Na, ^{42}K, ^{86}Rb, and ^{134}Cs cations in molten nitrates of lithium, sodium, and potassium can be explained by associate formation in the melt. The values of the activation energies of the mobilities of the "intrinsic" cations in molten nitrates of the alkali elements and a number of other individual salts are close to the values of the energies of formation of "holes" in the corresponding melts. The values of the activation energies of the mobilities of impurity cations in molten sodium nitrate practically do not differ from one another and from the value of the activation energy of the mobility of the "intrinsic" cation of the background salt. (auth)

2420 MUTUAL SOLUBILITY IN THE SYSTEM URANYL CHLORIDE-WATER–DIETHYL ETHER. Vdovenko, V. M.; Blokhina, V. K.; Suglobova, I. G. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 579-581(1972).

Translated from Radiokhimiya; 14: No. 4, 563-566(1972).

Results of a study of the mutual solubility in the system UO_2Cl_2–H_2O–$(C_2H_5)_2O$ show that diethyl ether poorly extracts uranyl chloride from aqueous solutions. An appreciable transfer of the salt to the ether begins when the aqueous layer contains 55 to 60% UO_2Cl_2. The solubility of UO_2Cl_2 increases with decreasing water content in the system and reaches a maximum (10%) when the equilibrium solid phase is the mixture of solvates $UO_2Cl_2 \cdot 2H_2O \cdot S$ and $UO_2Cl_2 \cdot H_2O \cdot 2S$. (DHM)

2421 COMPLEX FORMATION OF TRIVALENT AMERICIUM, CURIUM, AND PROMETHIUM IONS WITH PHOSPHONOACETIC ACID. Elesin, A. A.; Zaitsev, A. A.; Kazakova, S. S.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 558-562(1972).

Translated from Radiokhimiya; 14: No. 4, 541-545(1972).

The dissociation constants of phosphonoacetic acid at the temperature 25°C and ionic strength 0.2 (NH_4ClO_4) were determined. The complex formation of Am^{3+}, Cm^{3+}, and Pm^{3+} with PAA in the region of concentrations 1×10^{-3}–1×10^{-1} (pH = 2, 3, 4) was investigated by the method of ion exchange on a cation exchange resin, and it was shown that within the investigated region at ionic strength 0.2 and temperature 25°C, complexes with the composition $[M(H_2A)]^{2+}$, $[M(HA)]^+$, and $[M(HA)_2]^-$ are formed. (auth)

2422 COMPLEX FORMATION OF TRIVALENT AMERICIUM, CURIUM, AND PROMETHIUM IONS WITH HYDROXYMETHYL-PHOSPHONIC AND METHYLOLETHYLPHOSPHINIC ACIDS. Elesin, A. A.; Zaitsev, A. A.; Ivanovich, N. A.; Karaseva, V. A.; Yakovlev, G. N. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 563-567(1972).

Translated from Radiokhimiya; 14: No. 4, 546-551(1972).

The dissociation constants of methylolethylphosphinic and hydroxymethylphosphonic acids were determined at the temperature 25°C. The complex formation of trivalent americium, curium, and promethium ions at an ionic strength 0.2 (ammonium perchlorate) and temperature 25°C was investigated by the method of ion exchange on a cation exchange resin. (auth)

2423 IONIC EQUILIBRIA IN SOLUTIONS OF COMPLEXES OF URANYL WITH TRIDECYLAMMONIUM SALTS. Vdovenko,

V. M.; Ladygin, I. N.; Suglobov, D. N. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 568-573(1972).

Translated from Radiokhimiya; 14: No. 4, 552-558(1972).

In the spectra of solutions of anionic complexes of uranyl with the R_3NH^+ cation in nonpolar solvents (benzene, CCl_4), the cation–anion hydrogen bond is manifested not only in the low-frequency vibrational spectrum νNH, but also in the change in the vibrational spectrum of the complex anion. The degree of this change depends on the strength of the hydrogen bond and the nature of the acido-ligand. The interaction of R_3NH^+ with the complexes $[UO_2F_5]^{3-}$ and $[UO_2Cl_4]^{2-}$ weakens the uranium–ligand bond and causes dissociation of the complex with elimination of the trialkylammonium salt. In solutions of mixtures of complexes of uranyl and alkylammonium salts, a displacement of the cation R_3NH^+ from the complex anion to the anion of the salt, forming stronger H-bonds with R_3NH^+, is observed. In such solutions the existence of associates with the probable composition: $[(R_3NH)_nNO_3]^{(n-1)+}$ and $[(R_3 \cdot NH)_n Cl]^{(n-1)+}$ (n = 1, 2, 3) is detected. (auth)

2424 STUDY OF THE COMPLEX FORMATION OF THE ACTINIDE ELEMENTS IN HNO_3 AND $HClO_4$ BY PAPER CHROMATOGRAPHY. Korotkin, Yu. S. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 551-554(1972).

Translated from Radiokhimiya; 14: No. 4, 534-538(1972).

It was shown that the linearity of the dependence $R_f = f[HNO_3]$ for the actinide elements is associated with the complex formation of these elements in nitric acid. The use of the method of R_f spectra permitted conclusions to be drawn on the composition and region of existence of nitrate complexes of the actinide elements and their valence forms in nitric acid. (auth)

2425 QUALITY CONTROL OF RADIOPHARMACEUTICALS. Hoeke, M. Izotoptechnika; 15: No. 8-9, 434-435(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972).

See CONF-720985–.

2426 SOME NEPTUNIUM SELENIDES. Damien, D. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France); Damien, N.; Jove, J.; Charvillat, J. P. (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). Inorg. Nucl. Chem. Lett.; 9: No. 6, 649-655(Jun 1973).

Although many papers dealing with the transuranium element chalcogenides have been published, few of them have reported experimental data on neptunium selenides and tellurides. Only the b. c. c. Np_2Se_4 and Np_2Te_4 have been described. The neptunium sulphides have been more extensively studied, and the existence of several phases in the Np-S system have been shown. In order to extend these results to the other chalcogenides, and to compare them to the other transuranium element chalcogenides, the neptunium selenides and tellurides have been investigated. The preparation, thermal stability and x-ray characterization of the following neptunium selenides are reported: $NpSe_3$, Np_3Se_8 and γNp_2Se_3. (auth)

2427 IONIC SPECIES FORMED BY THE HYDROLYSIS OF HEXAVALENT URANIUM ION. Mavrodin-Tarabic, M. (Centre de Chimie Physique, Bucharest). Rev. Roum. Chim.; 18: No. 1, 73-88(Jan 1973). (In French).

The nature and stability of the ionic species formed by the hydrolysis of hexavalent uranium ion in inert perchloric acid medium were determined by spectrophotometric and pH methods. It was shown that, in the pH range above 2.5, the hydrolysis of UO_2^{2+} takes place by a series of reactions that depend on the pH and that lead to the formation of polynuclear complexes of the type $U_2O_5^{2+}$ and $U_3O_8^{2+}$ characterized by the average values of the equilibrium constants $K_1 = 1 \times 10^{-6}$ and $K_2 = 1 \times 10^{-7}$. (tr-auth)

2428 SOME ACTUAL PROBLEMS OF RADIOCHEMISTRY. Spitzin, V. I.; Michejew, N. B. (Inst. for Physical Chemistry, Moscow). Isotopenpraxis; 8: No. 10, 365-372(Oct 1972). (In German).

From the standpoint of radiochemistry, various methods are discussed, such as co-crystallization, extraction, and chromatography. Their application is described particularly with respect to the production of technetium and astatine. The chemical properties of these elements are also described. Subsequently, the transuranium elements up to 105 are discussed, as well as the search for the super-heavy elements $^{294}110$, $^{298}114$, and $^{310}126$. (HBG)

2429 REDUCTIVE AMINATION OF α-FORMYL LACTONES. A Route to α-Methylene Lactones. Harmon, A. D.; Hutchinson, C. R. (Univ. of Connecticut, Storrs). Tetrahedron Lett.; No. 15, 1293-1296(Apr 1973).

The development is reported of a new synthetic route to α-methylene-γ and δ-lactones based on the reductive amination of α-formyl lactones. As examples, the preparation of α-methylene-γ-butyrolactone and α-methylene-δ-valerolactone are described and the yields are given. The reductive amination was carried out according to the method of Borch et al. (J. Amer. Chem. Soc.; 93: 2897 (1971)). The several compounds were characterized by infrared and NMR spectroscopy as well as by boiling point (or melting point) and mass spectroscopy. Some studies were carried out on the isotopic labelling of such compounds with deuterium or tritium, using α-methylene-γ-butyrolactone as a model compound. (UK)

2430 ELECTROCHEMICAL BEHAVIOUR OF U(IV) IN NaCl–$AlCl_3$ MELTS. Martinot, L.; Gerard, T.; Duyckaerts, G. (Univ., Liege). Inorg. Nucl. Chem. Lett.; 9: No. 6, 657-665 (Jun 1973).

A chronopotentiometric study of the reaction U(IV) + e → U(III) in molten NaCl–$AlCl_3$(50–50) and NaCl–$AlCl_3$(38.2–61.8) is reported. For both melts the diffusion coefficients and activation energies for diffusion are calculated in the temperature range 250 to 400°C. An estimate of the electrochemical transfer coefficient and of the activation energy of the electrochemical reaction is also reported. The slow step in the reduction reaction is the electron transfer. (auth)

2431 INVESTIGATION OF COMPLEXES OF THE URANYL ION WITH DI-N-HEPTYLPHOSPHINIC ACID. Vdovenko, V. M.; Vavilov, N. G. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 574-578(1972).

Translated from Radiokhimiya; 14: No. 4, 558-563(1972).

The complexes formed between DHPA and the uranyl ion were investigated by the methods of cryoscopy and ir spectroscopy. The following scheme of conversion from one complex to another as the extraction reagent becomes saturated with uranium was proposed: $UO_2X_2 \cdot 2HX \rightarrow UO_2X_2 \cdot HX \rightarrow (UO_2X_2)_n \cdot HX \rightarrow (UO_2X_2)_m$, where $1 < n < m$. It was found that in the complex $(UO_2X_2)_m$ the value of m = 10 to 12. When such solutions are exposed for 10 days, the value of m increases to 25. The possibility of joint extraction of uranyl and nitrate ions from aqueous solutions containing less than 1 M nitric acid was demonstrated. (auth)

2432 POLAROGRAPHIC BEHAVIOUR OF URANIUM IN SOLUTIONS OF HYDROQUINONE. El Inany, G.; Veselinovic, D. S. (Inst. of Physical Chemistry, Belgrade). Bull. Soc. Chim. Beograd; 36: No. 9-10, 345–351(1971).

During the reduction of uranium(VI) in solutions of hydroquinone at the dropping mercury electrode (D. M. E.) different waves were obtained depending on solution pH and concentration of hydroquinone. In weak acid media, uranium gives a stable complex that is not reducible at the D. M. E. In acid medium (pH < 5) two waves appear at low concentrations of hydroquinone (0.001 to 0.128 M). Their half-wave potentials depend on the pH of the solution and on the concentration of hydroquinone. Both waves are due to one electron reduction (VI → V) and (V → IV). From the change of half-wave potentials and diffusion currents of the waves with pH and concentration of hydroquinone, it was concluded that U(VI), U(V), and U(IV) give complexes with hydroquinone. At high concentrations of hydroquinone (0.2 M) uranium has only one wave well-defined in the pH range of 2 to 4.42, with $E_{\frac{1}{2}} = -0.26$ V vs. S. C. E. The diffusion current is a linear function of the concentration of uranium. (auth)

2433 CRYSTAL STRUCTURE OF THORIUM(IV) TETRAKIS(TRIFLUOROACETYLACETONATE). Wessels, G. F. S.; Leipoldt, J. G.; Bok, L. D. C. (Univ. of the Orange Free State, Bloemfontein, S. Afr.). Z. Anorg. Allg. Chem.; 393: No. 3, 284-294(Nov 1972).

The crystal structure of the compound thorium(IV)tetrakis(trifluoroacetylacetonate) was determined by means of a three-dimensional x-ray analysis. The space group is C2/c and the cell dimensions are a = 25.05 Å, b = 6.43 Å, c = 21.3 Å, β = 125.4°, with Z = 4. The thorium atom is coordinated by 8 oxygen atoms in the form of an 1111 (D_4–422) antiprism. The mean of the Th–O distances is 2.39 Å with a standard deviation ±0.04 Å. Trifluoroacetylacetonate rings are approximately planar, except for the CH_3 and CF_3 groups, which show significant deviations. The Th–O bonds form angles of approximately 72 and 50° with the theoretical $\bar{8}$-axis of the antiprism. The structure is stabilized by van der Waals contacts between neighboring molecules. The refinement of the atomic positions, the anisotropic temperature parameter of thorium, and isotropic temperature parameters of all the other atoms by the least squares method, has given a reliability index of 0.148. (auth)

2434 NEW URANYL COMPOUNDS WITH PYRIMIDINE DERIVATIVES. Popea, F.; Marculescu, C.; Pirlog, C. (Centre

of Physical Chemistry, Bucharest). Rev. Roum. Chim.; 18: No. 2, 247-255(Feb 1973).

Three new uranyl compounds of the general formula $ML_2 \cdot nH_2O$ are presented (M = UO_2; L = barbituric acid, thiobarbituric acid, or 5-ethylbarbituric acid). They are characterized by thermal behavior, x-ray diffraction studies, uv and visible reflectance spectra, as well as ir vibration spectra. (auth)

2435 PROCESS FOR DECONTAMINATION OF NEUTRON-IRRADIATED BERYLLIUM. Lin, K. H. (to United States Atomic Energy Commission). U. S. Patent 3,716,616. 13 Feb 1973. Filed date 24 Feb 1971. 4p.

A process for treating neutron-irradiated beryllium containing ^{60}Co is provided which comprises reacting the beryllium with molten stannous chloride under conditions which will produce beryllium chloride and subsequently distilling the beryllium chloride to recover a decontaminated beryllium chloride distillate. (auth)

2436 URANYL PYROPHOSPHATE COMPLEXES. V. The Precipitation Reaction of the Sodium Bis-Pyrophosphato-Uranylate Complex with the Cd^{2+} Ion. Dragulescu, C.; Vilceanu, N. (Centre of Chemistry, Timisoara, Romania). Rev. Roum. Chim.; 18: No. 1, 59-62(Jan 1973).

The conductometric and potentiometric study of the reaction of sodium bis-pyrophosphato-uranylate complex with $Cd(NO_3)_2$ shows the successive formation of the following combinations: $Na_2Cd[UO_2(NaP_2O_7)_2]$, $Na_2Cd[CdUO_2(P_2O_7)_2]$, and $Cd_2[CdUO_2(P_2O_7)_2]$. (auth)

2437 URANYL PYROPHOSPHATE COMPLEXES. III. The Monopyrophosphatopentauranyl Cation Complex. Dragulescu, C.; Vilceanu, N. (Center of Chemistry, Timisoara, Romania). Rev. Roum. Chim.; 18: No. 1, 49-52(Jan 1973).

The formation of one single monopyrophosphato-pentauranyl cation complex, $[(UO_2)_5H_2P_2O_7]^{8+}$, was found spectrophotometrically, in the 0.83 to 3.00 pH range. Its formation constant after the Newman and Hume method is $K_q = 0.0344$. (auth)

2438 URANYL PYROPHOSPHATE COMPLEXES. IV. Precipitation Reactions of the Pyrophosphatouranylate Complex Anions with the Ag^+ Ion. Dragulescu, C.; Vilceanu, N.; Julean, I. (Center of Chemistry, Timisoara, Rumania). Rev. Roum. Chim.; 18: No. 1, 53-58(Jan 1973).

The formation of the following complex salts, $Ag_6[UO_2(P_2O_7)_2]$, $Ag_4Na_2[UO_2(P_2O_7)_2]$, $AgNa[UO_2(P_2O_7)]$, and $Ag_2[UO_2(P_2O_7)]$, compounds derived from the bis- and monopyrophosphato-uranylate complex anions, was evidenced conductometrically and radiometrically. (auth)

2439 SPECTROPHOTOMETRIC STUDIES OF URANYL CHELATE OF 7-IODO-8-HYDROXYQUINOLINE-5-SULPHONIC ACID. Hseu, T. M.; Kuo, K. N. (National Taiwan Univ., Taipei). J. Chin. Chem. Soc. (Taiwan); 19: No. 4, 161-171(Dec 1972).

The uranyl chelate of 7-iodo-8-hydroxyquinoline-5-sulfonic acid (ferron) was studied spectrophotometrically in aqueous solution at 25°C and at an ionic strength of 0.1 M. The formation of this chelate was pH dependent, and the optimum pH range was between 5.4 to 5.9. Its mole ratio of ligand to uranyl ion was found to be 2 to 1 and the stability constant, log K, was determined as 13.32 ± 0.08. By using the wavelength of 365 mμ, the determination of trace amounts of uranyl ions with a sensitivity of 0.54 γ/cm^2 was possible. (auth)

2440 INFLUENCE OF URANIUM HEXAFLUORIDE AND OTHER CORROSIVE VOLATILE COMPOUNDS ON POLYMER SUPPORTS USED IN GAS–LIQUID CHROMATOGRAPHY. Aubeau, R.; Blandenet, G.; Leccia, F. Chromatographia; No. 5, 240-251 (1972). (In French).

Four commercial polymer supports are compared: Chromosorb T, Soreflon 5. A., Voltalef 300 LD and Fluoropak 80. This study is divided into three parts: physical measurements, gas-solid and gas-liquid chromatography, and activity coefficient determinations. Physical data include specific area determinations, porosity and electron microscopy measurements. They show big differences in the various materials, some of them showing a very similar texture to that of silica supports commonly used in gas-liquid chromatography. Separations using gas liquid and gas-solid chromatography show the support surface activity in relation to the solutes being examined. The variation in activity coefficients also confirms the support influence especially for lower loadings of stationary phase. The choice of the support must be made in accordance with the type of analysis to be performed; i. e. Chromosorb T support should be used in separating the MoF_6–UF_6 mixture whereas Voltalef 300 LD support should be used for compounds with a shorter elution time. (GF)

2441 IDENTIFICATION OF SHORT-LIVED ISOTOPES OF ZIRCONIUM, NIOBIUM, MOLYBDENUM, AND TECHNETIUM IN FISSION BY RAPID SOLVENT EXTRACTION TECHNIQUES. Trautmann, N.; (Univ., Mainz); Kaffrell, N.; Behlich, H. W.; Folger, H.; Herrmann, G.; Huebscher, D.; Ahrens, H. Radiochim. Acta; 18: No. 2, 86-101(1972).

Rapid, automated separation procedures for zirconium and technetium from fission products based on solvent extraction techniques were developed. They require 4.0 sec for the isolation of zirconium and 7.5 sec for technetium. The procedures were applied to identify new nuclides and to confirm already reported nuclides by following the decay of their strongest γ-ray peaks and by demonstrating their genetic relationship with known nuclides. Results are presented for 1.9-sec ^{97}Y; 2.0-sec ^{99}Zr, 1.3-sec ^{100}Zr, 2.0-sec ^{101}Zr, and 0.8-sec ^{102}Zr; 15-sec ^{99}Nb, 7.1-sec ^{100}Nb, 7.1-sec ^{101}Nb, and 2.9-sec ^{102}Nb; 64-sec ^{104}Mo, 48-sec ^{105}Mo, 11-sec ^{106}Mo, ~5-sec ^{107}Mo, and 1.5-sec ^{108}Mo; 50-sec ^{103}Tc, 18-min ^{104}Tc, 7.7-min ^{105}Tc, 36-sec ^{106}Tc, 21-sec ^{107}Tc, and 5.0-sec ^{108}Tc. (auth)

2442 POLARIZATION SPECTRUM OF PHOTOLUMINESCENCE OF A CRYSTAL OF AMMONIUM URANYL OXALATE. Komyak, A. I.; Sleptsov, S. E. Zh. Prikl. Spektrosk.; 17: No. 5, 804-809(Nov 1972). (In Russian).

The luminescence and infrared spectra of a crystal of $(NH_4)_2[UO_2(C_2O_4)_2 \cdot 2H_2O]H_2O$ (AUO) were studied. The luminescence at 77°K was observed. It was established from the dichroism of ir absorption that the predominant orientation of the UO_2^{2+} ion was in the direction of the optical axis. Some qualitative evaluation of the U-ligand bonds and of the low quantum yield of luminescence of the AUO crystal was made. Well-defined interpretations of the observed frequencies could be drawn from the relative intensities, polarization lines of the luminescence spectrum and ir spectrum of AUO. (tr-auth)

2443 PROTACTINIUM(V) ETHOXIDE. Maddock, A. G.; Pires de Matos, A. (Chemical Labs., Cambridge, Eng.). Radiochim. Acta; 18: No. 2, 71-73 (1972).

The preparation and some properties of protactinium(V) ethoxide are described. The extent of polymerization of the ethoxide in benzene solution is reported. The polymerization is confirmed by the infrared spectrum of the compound. (auth)

2444 ELECTROCHEMICAL AND CHEMICAL REDUCTION OF PERTECHNATE. Hodara, I.; Silverman, C.; Balouka, I. (Nuclear Research Centre, Beer-Sheva, Israel). Radiochim. Acta; 18: No. 2, 67-71(1972).

The reduction of pertechnate ion by various means is studied. Ascorbic acid and metamizol (1-phenyl-2,3-dimethyl-5-pyrazolone-4-methylaminomethanesulfonate) efficiently reduce pertechnate in solutions 2M in HCl. Alternatively, the reduction may be carried out at p_H 4 by constant current electrolysis but the valency of the product cannot be determined with certainty. Polarograms recorded during various stages of the electrolysis at p_H 4 indicate that the rate of adsorption of pertechnate on the electrode may control the current. The possibility of chemical interaction between various species of technetium in solution is also postulated. (auth)

Radioactive Waste Treatment

Refer also to abstracts 2240 and 2559.

2445 (AERE-M-2223) LEACHING OF RADIOACTIVE SLUDGES INCORPORATED IN CEMENT AND BITUMEN. Smith, A. J. (Atomic Energy Research Establishment, Harwell (England)). May 1969. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Static leaching tests were carried out on samples of radioactive sludges incorporated in cement and bitumen. The method used and the results obtained are included, together with results of compressive strength tests on sludge/cement mixes. (auth)

2446 (BNWL-CC-1695) EVALUATION OF STRONTIUM AND CESIUM COMPOUNDS FOR WASTE PACKAGING. Soine, T. S.; Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash.). 26 Jun 1968. 20p. Dep. NTIS $3.00.

Various methods have been evaluated for the long-term disposal of high level cesium and strontium liquid wastes. The method selected involves conversion of the separated ^{90}Sr and ^{137}Cs liquid streams to suitable solid compounds followed by encapsulation of the solids in metal cans. Various cesium and strontium compounds were evaluated as to their suitability for encapsulation for packaging and long-term storage. Cesium chloride and strontium fluoride were selected as the primary candidates. The bases for their selection were three-fold: (1) the shortest development time, prior to starting plant design, could be achieved with CsCl and SrF_2, (2) considerable compatibility data (up to nine years) is available for the two compounds, and (3) it was felt that CsCl and SrF_2 could be prepared and packaged at the lowest unit cost. Two secondary candidates, cesium diuranate and strontium pyrophosphate, were selected as possible replacements for the chloride

and fluoride if either or both should be rejected for any reason. Initial studies indicate that the development of technology for design of a compact waste packaging plant should be based on the selection of cesium chloride and strontium fluoride as the compounds to be packaged. In addition, approximately 20% of the development program should be devoted to developing the technology of the two secondary candidates. (auth)

2447 (CONF-721030–, pp 480-515) PROCESS FOR REMOVING RADIOACTIVE WASTES FROM LIQUID STREAMS. Kirby, H. W.; Blane, D. E.; Smolin, R. I. (Mound Lab., Miamisburg, OH). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25–27, 1972.

A process is under development at Mound Laboratory to remove radioactive waste (principally plutonium-238) from process water prior to discharge of the water to the Miami River. The contaminated water, as normally received, is at a pH between 6 and 9. Under these conditions, plutonium in all its oxidation states is hydrolyzed; however, the level of the radioactive solids varies from about 50 ppM down to about 50 ppB and the plutonium remains in a colloidal or subcolloidal condition. The permissible concentration for discharge to the river is about 50 parts per trillion. Pilot plant tests show that 95 to 99% of the radioactive material is removed by adsorption on diatomaceous earth. The remainder is removed by passage through a bed of either dibasic or tribasic calcium phosphate. Ground phosphate rock is equally effective in removing the radioactive material if the flow rate is controlled to permit sufficient contact time. Parameters for optimizing the process are now under study. (auth)

2448 (CONF-721030-, pp 524-539) DESIGN FOR ^{85}Kr ENRICHMENT BY THERMAL DIFFUSION. Schwind, R. A.; Rutherford, W. M. (Mound Lab., Miamisburg, OH). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

Substantial quantities of krypton having a krypton-85 concentration of less than 10% will become available if nuclear fuel-processing plants are required to collect the gaseous fission products rather than releasing them into the atmosphere. A modular thermal diffusion unit was designed for the enrichment of the krypton-85 to useful concentrations of greater than 45%. The design emphasizes reliability and integrity by incorporating no moving parts within the unit. The modular design also offers flexibility in the size of the enrichment facility that need be constructed at any time. (auth)

2449 (CONF-721107-6) SOLIDIFICATION OF HIGH-LEVEL RADIOACTIVE WASTES AT THE IDAHO CHEMICAL PROCESSING PLANT. Lakey, L. T.; Wheeler, B. R. (Allied Chemical Corp., Idaho Falls, Idaho). [nd]. 27p. Dep. NTIS $3.50.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Since 1963, high-level radioactive wastes at the U.S.A.E.C. Idaho Chemical Processing Plant have been solidified by the fluidized-bed calcination process. About 9×10^6 litres of liquid wastes from the reprocessing of aluminum- and zirconium-alloy fuels have been calcined to produce about 1,000 m^3 of granular solids. Decontamination factors of 10^7 on particulates and 10^6 on ^{106}Ru, which can volatilize at the calcination temperature, are being attained. The solids produced in the process are carried pneumatically to stainless-steel bins within underground concrete vaults. Though the granular product can be retrieved, the storage system is designed for a lifetime of over 500 years. Several improvements have been made which have increased plant capacity 50% above the design rate, and on-stream factors of 75 to 100% have been achieved in five operating campaigns. In addition, supporting work is directed at developing flowsheets for other wastes–e.g., high-salt wastes from second- and third-cycle extraction processing, neutralized Purex wastes, and contaminated organic wastes. (auth)

2450 (EPA/ORP–73-1) OBSERVATION OF AIRBORNE TRITIUM WASTE DISCHARGE FROM A NUCLEAR FUEL REPROCESSING PLANT. Cochran, J. A.; Griffin, W. R. Jr.; Troianello, E. J. (Office of Radiation Programs, Washington, D. C. (USA). Field Operations Div.). Feb 1973. 35p.

A study was conducted at West Valley Processing Plant to: (a) characterize the stack tritium effluent in the gaseous and water vapor forms, during normal plant operations, (b) determine the weekly average tritium air concentrations at five selected sites around the plant over a 4-month period, (c) evaluate methods used for sampling at the stack and in the environment, and (d) estimate the dose to the population in the immediate vicinity of the plant from tritium stack effluents. Characterization of tritium release from the stack was carried out during three reprocessing campaigns assumed to be typical of the NFS operation. Evaluation of the data indicates that the tritium release rate from the stack is 6.75×10^{-4} curies per megawatt-day burnup. Approximately 25 percent of the activity is in the gaseous state and 75 percent is in the water vapor state. The average annual release of tritium via the stack, considering the total fuel processed from 1966 to 1971, is estimated to be 500 curies per year. Data for the five air sampling stations around the site indicate that the plant contribution to the atmosphere is small. (auth)

2451 (HEDL-TME-73-22) TREATMENT OF LOW-LEVEL, ALPHA-CONTAMINATED SOLID WASTE BY ACID DIGESTION. Lerch, R. E.; Cooley, C. R. (Hanford Engineering Development Lab., Richland, Wash.). Apr 1973. Contract AT(45-1) 2170. 52p. Dep. NTIS $5.45.

Acid digestion is being developed at the Hanford Engineering Development Laboratory (HEDL) as a method for reducing the volume of bulky low-level alpha-contaminated wastes while converting the wastes to noncombustible residues. The process consists of decomposing combustible waste materials in hot (230 to 270°C) concentrated sulfuric acid in the presence of nitric acid oxidant. Acid digestion readily converts such wastes as ion exchange resin, poly(vinyl chloride), polyethylene, wood, paper, rags, styrofoam, Tygon, latex rubber, and neoprene rubber into a low volume, noncombustible chemical residue consisting mainly of inorganic sulfates. Plutonium can be readily recovered from the sulfate residue. Off-gases from the process include carbon monoxide and dioxide, sulfur dioxide, nitrogen, and oxides of nitrogen equal to from one to three liters of STP gas per gram of waste decomposed. (auth)

2452 (ORNL–4859) CALCULATIONS ON THE PERFORMANCE OF THE KALC PROCESS. Whatley, M. E. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 95p. Dep. NTIS $3.00.

The KALC (Kr Absorption in Liquid CO_2) process for removing Kr from the burner off-gas generated in the reprocessing of HTGR fuel elements was shown to be feasible in a calculational study using a mathematical model in the form of a computer program. The KALC process uses liquid CO_2 to scrub Kr from the burner off-gas which contains about 90% CO_2, some O_2, N_2, and CO_2, and traces of Kr and Xe. It operates at pressures from 13 to 20 atm and temperatures from −20°C to −40°C. This study did not include Xe. The absorber-fractionator system, which separates Kr from the other light gases in the CO_2 solvent, was found to require close control for satisfactory performance. A good variable for adjusting performance, and the one used in this study, is the reboiler vapor rate at the bottom of the fractionator. This study also showed the need for some condensation at the feed point, and a molar scrub rate at least 20 times the feed rate. The stripper-rectifier system, which removes Kr and other light gases from the solution produced by the absorber-fractionator, was studied separately. This system showed no critical variables, performing better at higher reboiler vapor rates and easily yielding Kr concentrations of several percent in the product. The main condenser load for this system should be at the feed point rather than in the final condenser in order to keep flows in the rectifier section small. Significant variables in the operation of KALC were examined, and their effects on overall performance were noted and discussed. (auth)

2453 RECOVERY OF USEFUL ISOTOPES FROM REPROCESSING WASTES. Hoshino, T. (Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 235-237 (Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

In the Power Reactor and Nuclear Fuel Development Corporation (PNC), a fuel reprocessing plant by the Purex method, with capacity of 0.7 ton/day, will be put in operation in 1975. In this connection, recovery of ^{237}Np in particular from liquid waste is described. The value of ^{237}Np in the waste is predominantly large, so that its recovery is incorporated in many fuel reprocessing plants in the world. Formation of ^{237}Np and ^{238}Pu in nuclear reactors and subsequent recovery of the ^{238}Pu are outlined. Studies are in progress to establish technology of recovering the ^{239}Np from the medium-level liquid waste before the fuel reprocessing plant is put in operation. The relation of recovering useful radioisotopes to the fuel reprocessing economy is also described. (Japan)

2454 SEPARATION TECHNOLOGY DEVELOPMENT FOR VALUABLE RADIOISOTOPES FROM FISSION PRODUCTS. Amano, H. (Japan Atomic Energy Research Inst., Tokyo).

Proc. Jap. Conf. Radioisotop.; No. 10, 238-240(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Gaseous and liquid wastes from the Purex method of fuel reprocessing contain large amounts of useful radioisotopes and stable nuclides of very low natural abundance. In view of Japan's program for extracting useful radioisotopes in fuel reprocessing, world development in this field and also that in Japan are reviewed. Mainly used for this purpose at present are ion-exchange and solvent extraction methods. High-quantity gaseous waste treatment, including separation of ^3H, is one possibility. To extract appreciable quantities of radioisotopes from the liquid waste economically, it is desirable to separate all the useful individual ones in a systematic manner. While solvent extraction may be used for this purpose, ion exchange is advantageous in obtaining high separation efficiency. Stages of development to be followed by Japan in this field are proposed. (Japan)

2455 REMOVAL OF RADIOIODINE FROM FLOWING HUMID AIR AND STEAM BY IMPREGNATED CHARCOALS. Kitani, S.; Takada, J.; Uno. S. (Japan Atomic Energy Research Inst., Tokai). Kuki Seijo; 10: No. 2, 63-70(Jun 1972). (In Japanese).

Removal of I_2 and CH_3I from flowing humid air and steam with three types of impregnated charcoal (MSA-85851, BC-727 and SnI_2-impregnated) was investigated at temperature between 20 and 140°C. Iodine was labeled with ^{131}I, and concentration in gas flow was around 5 mg/m^3. Penetration ratio of I_2 and CH_3I through charcoal layers was measured under different conditions. Desorption of the trapped CH_3I from the charcoal was also investigated. Three kinds of the chemical substances impregnated in the charcoal did not interrupt the trapping of I_2. They improved markedly the ability of trapping CH_3I of the charcoal. The adsorbed CH_3I moved in the charcoal layers. Desorption of the CH_3I was observed to continue about 6 hr, and ratio of the desorption came to be 0.6%. Mechanism of the desorption is discussed. (Japan)

2456 PERFORMANCE CHARACTERISTICS OF FILTER PAPERS FOR RADIOACTIVE AEROSOL SAMPLING. Yoshida, Y.; Ikezawa, Y. (Japan Atomic Energy Research Inst., Tokai). Kuki Seijo; 10: No. 2, 41-48(Jun 1972). (In Japanese).

Characteristics of various filter paper are described, which seem useful for filter paper selection and the evaluation of radioactive aerosol concentration. Cellulose, cellulose asbestos, glass fibre, and membrane were evaluated as filter material. Physical properties of typical filter paper are listed in a table. Membrane type filter paper which is represented by Millipore AA filter paper shows very high collecting efficiency at any filtering speed, but the pressure loss is large. A few items such as the collecting efficiency vs. the pressure loss, particle size vs. the collecting efficiency, kinds of aerosol vs. the collecting efficiency, and absorption effect of the filter paper on α-emitting particles, are described in detail. In case of the radioactive aerosol, it is required that the filter paper for radioactive aerosol sampling be highly efficient in collecting particles of submicron to several micron size. (Japan)

2457 METHOD OF REDUCING THE RELEASE OF MOBILE CONTAMINANTS FROM GRANULAR SOLIDS. Godfrey, W. L. (to United States Atomic Energy Commission). U. S. Patent 3,723,338. 27 Mar 1973. Filed date 28 Apr 1971. 6p.

Granular solids, particularly soil and like solids, containing mobile contaminants, as for example sorbed ionic species, are injected with a hardenable liquid, as for example a thermosetting resin, to fill the interstitial voids and enclose the individual particles. In an important specific embodiment, soil containing radioactive species and particularly soil containing ^{90}Sr and ^{137}Cs is injected with a thermosettable composition comprising a dicarboxylic acid anhydride partial ester mixed with a polymerizable monomer and, preferably, also a polyfunctional material such as polyepoxide, and allowed to polymerize with or without curing agents whereby the composition polymerizes around particles of the soil and immobilizes the radioactive material. (auth)

Radioisotope Production

2458 (BNL-17657) CYCLOTRON AND SHORT-LIVED HALOGEN ISOTOPES FOR RADIOPHARMACEUTICAL APPLICATIONS. Lambrecht, R. M.; Wolf, A. P. (Brookhaven National Lab., Upton, N. Y.). 1973. 22p. (CONF-730309-5; SM-171/79). Dep. NTIS $3.25.

From symposium on new developments in radiopharmaceuticals and labelled compounds; Copenhagen, Denmark (26 Mar 1973).

New cyclotron methods were developed for the production of ^{123}I and ^{18}F in good yield and high radiochemical purity. Iodine-123 is routinely obtained at BNL by the $^{122}Te(\alpha,3n)^{123}Xe \rightarrow {}^{123}I$ nuclear reactions with $E_\alpha = 46-35$ MeV used to produce the 2.1 hr half-life ^{123}Xe parent. The ^{123}Xe, which may be continuously removed from the isotopically enriched ^{122}Te target during the irradiation, is rigorously scrubbed to remove the ^{124}I impurity. After ~6.5 hrs the optimum yield and ≥99.8% radionucleic purity of ^{123}I is obtained. The only radiohalogen impurity is ^{125}I, which neither interferes with scintigraphic imaging nor deposits an appreciable radiation dose in the patient. Alternate nuclear reactions that can be used to produce ^{123}Xe, and selected direct nuclear reactions to produce ^{123}I are also evaluated. The $^{123}Xe(\beta^+,EC)^{123}I$ nuclear transformation was used to produce carrier-free iodinating reagents, such as ^{123}ICl, $Na^{123}I$, a new reactive ^{123}I species, and can also be used for excitation labeling. Carrier-free, anhydrous ^{18}F was produced by the $^{20}Ne(d,\alpha)^{18}F$ [E_d = 16.5 to 0 MeV] and the $^{20}Ne(^3He,x)^{18}Ne \xrightarrow[1.1\ sec]{\beta} {}^{18}F$ (x = 2p3n, ^3He2n, αn) nuclear reactions at E^3_{He} = 55 + 41 MeV. A specially prepared nickel irradiation vessel and flow system was designed to dynamically recover ^{18}F from the target. The fluorinating reagents that can be obtained are ^{18}F, $X^{18}F$ (X = F, I, H or Cl), $CF_2{}^{18}FO^{18}F$, $NO^{18}F$, and $^{18}F^-$. The $^{18}Ne(\beta^+)^{18}F$ nuclear transformation is a potential method for excitation labeling with ^{18}F. Isotope production rates, and experimental parameters such as target fabrication, repurification and recovery procedures, and examples of the preparation of the iodinating and fluorinating reagents used to obtain labeled radiopharmaceuticals are discussed. The cyclotron production of other medically interesting halogen nuclides is summarized. (auth)

2459 PROBLEMS IN THE RADIOPHARMACEUTICAL PROCESSING OF CYCLOTRON-PRODUCED NUCLIDES. Kurata, K. (Dainabot Radioisotope Labs., Ltd., Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 486-488(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Features of pharmaceutical radioisotopes produced in cyclotrons are compared with those produced in reactors. The significance of those features for the processing, testing, and distribution of the pharmaceutical radioisotopes are discussed. The importance of selecting the proper reaction and target material for the ensuing processing is explained along with the examples of ^{18}F and ^{123}I production. The outline and problems of the processing, namely synthesis of target compounds, purification, adjustment, and sterilization, are also described. The outline of the test is reviewed on the following test items: purity test of radionuclides, test of radiochemical purity, and asepsis test and exothermic substance test. It is suggested that for the isotopes of short half-life, some technical and legal measures are required. As the problems of the distribution, particularly for the isotopes of very short half-life, necessity of on-line processing at the site of cyclotrons is discussed. In conclusion, a systematic method of production and management is required for the effective and safe use of the pharmaceutical radioisotopes, particularly those of short half-life. (Japan)

2460 SEPARATION OF THE CONSTITUENTS OF THE NUCLEAR COUPLE Mo-Tc ON A PERTITANIC ACID FILTER. Guillaume, M. (Univ., Liege). Radiochem. Radioanal. Lett.; 13: No. 5-6, 307-318(30 Apr 1973). (In French).

A new ^{99m}Tc generator using pertitanic acid as adsorbent was investigated. The two chief advantages are high Mo adsorbing capacity and high elution yield. From a column of pertitanic acid (20 g) charged with 300 mg of molybdenum (MoO_3) irradiated in a thermal flux of 2×10^{14} n cm^{-2} sec^{-1}, ^{99m}Tc can be eluted by 0.1N HCl with a total activity of more than 900 mCi for the first milking, 30 h after the irradiation and more than 10^{-4} nuclear purity. (auth)

2461 FOURTH MEETING OF ISOTOPE PRODUCERS, BUDAPEST, SEPTEMBER 4-6, 1972. Izotoptechnika; 15: No. 8-9, 399-477(1972). (In Hungarian). (CONF-720985-).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972).

A separate abstract was prepared for each of the fifteen papers presented. (DHM)

For abstracts of individual papers see: 2425 and 2462-2475.

2462 CHANGING FACE OF RADIOISOTOPE PRODUCTION. Maynard, I. C. (Radiochemical Centre, Amersham, Eng.). Izotoptechnika; 15: No. 8-9, 399-405(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972).

See CONF-720985-.

Topics discussed include: enrichment of target materials, production in small volumes, application of specific enzymatic reactions in labeling, closed sources with various shapes, and the increase in demand for in vitro kits. (DHM)

2463 PRODUCTION OF RADIOISOTOPES AT THE REACTOR CENTRE SEIBERSDORF. Angelberger, P.; Burtscher, A.

(Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H, Seibersdorf). Izotoptechnika; 15: No. 8-9, 406-409(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972).

See CONF-720985-.

Topics discussed include: production of ^{192}Ir and labeling of petrol toluidine blue, and 19-iodocholesterol with ^{131}I. (DHM)

2464 RADIOISOTOPE PRODUCTION AND QUALITY CONTROL METHODS USED IN CZECHOSLOVAKIA. Chorvat, K. (Ustav pro Vyzkomu, Vyrobu a Vyuziti Radioisotopu, Prague); Svobada, K.; Hradil, M. Izotoptechnika; 15: No. 8-9, 410-417 (1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

The Institute produces isotopes in Prague and Rez. Methods of preparation and quality control procedures are discussed. (DHM)

2465 RADIOISOTOPE PRODUCTION IN DENMARK. Jacobsen, U.; Kruse, B. (Danish Atomic Energy Commission Research Establishment, Risoe). Izotoptechnika; 15: No. 8-9, 418-419 (1972). (In Hungarian).

From fourth meeting of iostope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

2466 RADIOISOTOPE PRODUCTION ACTIVITIES AT THE DEMOCRITOS NUCLEAR RESEARCH CENTER. Constantinides, M. G. (Democritus Nuclear Research Center, Athens). Izotoptechnika; 15: No. 8-9, 420-424(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Developments in isotope production at Democritos Nuclear Research Center since 1962 are presented including production and user data. (DHM)

2467 ANALYTICAL CONTROL OF RADIOPHARMACEUTICALS PRODUCED AT DEMOCRITOS NUCLEAR RESEARCH CENTER. Archimandritis, S.; Belkas, E. P.; Dassiou, C. A. (Democritus Nuclear Research Center, Athens). Izotoptechnika; 15: No. 8-9, 425-433(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Arrangement and instrumentation of the laboratories at Democritus Nuclear Research Center are considered as well as problems in testing of ^{99m}Tc, ^{131}I, and ^{198}Au. (DHM)

2468 PRODUCTION OF RADIOISOTOPES AT THE BORIS KIDRIC INSTITUTE, VINCA, YUGOSLAVIA. Izotoptechnika; 15: No. 8-9, 436-438(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

2469 PRODUCTION OF RADIOISOTOPES IN POLAND. Deptula, C.; Siuda, A. (Instytut Badan Jadrowych, Swierk, Poland). Izotoptechnika; 15: No. 8-9, 439-445(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Topics considered include: the reactor, production laboratories, production data, and quality control. (DHM)

2470 PRODUCTION OF RADIOISOTOPES IN HUNGARY. Lengyel, T. (MTA Izotop Intezete, Budapest). Izotoptechnika; 15: No. 8-9, 446-451(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Some topics discussed include: production data, separation methods, lowering of demands for isotope cows, and arrangement of laboratories. (DHM)

2471 PRESENT SITUATION AND TRENDS OF ISOTOPE PRODUCTION IN THE GERMAN DEMOCRATIC REPUBLIC. Vormum, G.; Muenze, R. Izotoptechnika; 15: No. 8-9, 452-457(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Topics discussed include production of ^{60}Co and ^{14}C in power reactors; medical, biological, and chemical applications; new radiopharmaceutical preparations; and in vitro kits. (DHM)

2472 PAST AND FUTURE OF ISOTOPE PRODUCTION AND APPLICATIONS IN SPAIN. Dominquez, G.; de la Cruz, F.; Cellini, R. F. (Junta de Energia Nuclear, Madrid). Izotoptechnika; 15: No. 8-9, 458-460(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

2473 RADIOISOTOPE PRODUCTION IN STUDSVIK, SWEDEN. Isacson, C. (Aktiebolaget Atomenergi, Studsvik, Sweden). Izotoptechnika; 15: No. 8-9, 461-464(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Topics discussed include the reactor, special pertechnetate cows, technetium colloids, and Tc-labeled HSA. (DHM)

2474 STATUS AND SOME DEVELOPMENT TRENDS IN RADIOISOTOPES PRODUCTION IN THE USSR. Bochkarev, V. V.; Kulysh, F. F. Izotoptechnika; 15: No. 8-9, 465-470(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

Some topics considered are: volume of production, high intensity γ sources, neutron generators, reference sources, ^{54}Mn and ^{55}Fe with high specific activity, kits and production of short-lived isotopes. (DHM)

2475 PRODUCTION OF ARTIFICIAL RADIOELEMENTS IN TURKEY. Tomek, F. (Cekmece Nuclear Research Center, Istanbul). Izotoptechnika; 15: No. 8-9, 471-477(1972). (In Hungarian).

From fourth meeting of isotope producers; Budapest, Hungary (4 Sep 1972). See CONF-720985-.

2476 TAILORING AND PRODUCTION OF RADIOISOTOPES IN NUCLEAR MEDICINE. Iio, M. (Tokyo Univ.). Genshiryoku Kogyo; 18: No. 11, 14-19(Nov 1972). (In Japanese).

Current aspects of radioisotope application for nuclear medicine and development of radiopharmaceuticals with reference to literature are reviewed. For selection of radioisotopes to be used for diagnostic techniques the following criteria should be used: the most reliable information and the most clear radiographic images should be attained, and biological exposure dose should be kept minimum considering detection devices, biological half-life, radiation doses, labeling and toxicity of the applied radioisotope. Future prospect of development of radioisotope production and use of cyclotron is discussed with respects to provision of nuclear medical centers and extensive use of gamma cameras. (Japan)

2477 YIELD OF ^{52}Fe FOR THE REACTIONS OF ^{3}He AND α ON CHROMIUM. Akiha, F.; Aburai, T.; Nozaki, T.; Murakami, Y. (Japan Atomic Energy Research Inst., Tokyo). Radiochim. Acta; 18: No. 2, 108-111(1972).

Excitation curves for the formation of ^{52}Fe by the reaction of ^{3}He and of α-particles on natural chromium were measured up to 44 MeV energy. Relative thick target yields for 40 MeV incident energy were found to be as follows: α on natural chromium 0.2; ^{3}He on natural chromium, 1.0; α on 100% enriched ^{50}Cr, 4. When ^{3}He-particles are accelerated up to 40 MeV, bombardment of natural chromium with the ^{3}He-beam proved to be more useful for ^{52}Fe production than that of enriched ^{50}Cr with an α-beam, yielding about 1 mCi of ^{52}Fe per hour for 25 μA flux. (auth)

2478 PRESENT AND FUTURE STATUS OF RADIOISOTOPE PRODUCTION. Mochizuki, T. (Japan Atomic Energy Research Inst., Takasaki); Ichiyanagi, K. Genshiryoku Kogyo; 18: No. 11, 3-8(Nov 1972). (In Japanese).

In Japan, primary RIs (purified ones) are produced mainly in the JAERI, secondary products (medical supplies and labelled ones) are by pharmaceutical firms, while their distribution is carried out by Japan Isotope Association. Though domestic production of the primary RIs is on the increase in recent years, the main part is still the manufacture of the secondary products. Features in this field in Japan are steady growth of medical RIs, need for economic consideration in the primary RI production, and increase in the variety of RIs. The present and future of the RIs production in Japan are described with respect to trend in overseas leading countries; the RI production and its future in the JAERI; and contribution of FP recovery to atomic energy development. (Japan)

2479 KIT FOR CARRIER-FREE ^{123}I-SODIUM IODIDE. VIII. Lambrecht, R. M.; Norton, E.; Wolf, A. P. (Brookhaven National Lab., Upton, NY). J. Nucl. Med.; 14: No. 5, 269-273(May 1973).

A kit preparation for high-purity carrier-free ^{123}I-sodium iodide from the ^{123}Xe → ^{123}I generator is described. The optimum dissolution procedure, the characteristics of the Na^{123}I from the suggested kit preparation, and the features of the kit are discussed. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 2560 and 3170.

2480 (BLG-472) EVALUATION OF FLUIDIZED BED REACTORS, CONTINUOUS AND IN CASCADE IN THE REWORKING OF NUCLEAR FUEL BY FLUORINATION. Decamps, F.; Harnie,

R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Aug 1972. 31p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

A relatively simple model is proposed for the evaluation of continuous fluidized bed reactors for the hydrofluorination and the fluorination of nuclear fuels. The model is derived from the two-phase model proposed by Davidson–Harrison. The essential feature of the model is the unambiguous dissociation of the kinetic parameter from the parameter that is a characteristic for the gas-solid contact pattern in the fluidized bed. Predicted conversions with contact parameters extrapolated from the literature correspond to experimental conversions, obtained in semi-pilot runs. Within the fluidization conditions and bed geometries, imposed by the nuclear nature of the solid, the conversion is limited by the kinetics rather than by the gas-solid contact. (auth)

2481 (GERHTR–42) REPROCESSING OF THORIUM-CONTAINING NUCLEAR FUELS. Report on Activities in the First Half Year 1970. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Chemische Technologie). Aug 1970. 87p. Dep. NTIS $6.50.

Work performed under United States–German High Temperature Reactor Research Exchange Program.

Research progress is reported on Thorex flowsheet, KFA-TBP 23/25 flowsheet, Chlorinex flowsheet, treatment of highly radioactive wastes, hot analysis and measuring methods, studies on nuclide recovery in the reprocessing of thorium-containing fuels, Jupiter test plant, and head end study. (DHM)

2482 (ICP–1019) FIRST NEPTUNIUM PROCESSING CAMPAIGN AT ICPP. Johnson, J. E.; Lewis, L. C.; Jacobson, M. E.; Valentine, M. K. (Allied Chemical Corp., Idaho Falls, Idaho. Idaho Chemical Programs Operations Office). Feb 1973. Contract AT(10-1)-1375. 29p. Dep. NTIS $3.00.

Final processing of a Np–Pu–U solution, accumulated over a seven-year period at ICPP, was successfully completed during a three-week campaign in June, 1972. The uranium was partitioned from the neptunium and plutonium by an acid-deficient Hexone extraction in the presence of ferrous sulfamate. The neptunium and plutonium were then oxidized to Np(VI) and Pu(VI) with chromic acid and coextracted in an acid–Hexone extraction cycle to decontaminate them from fission products. Neptunium and plutonium extraction efficiencies exceeded 99% in the acid–Hexone cycle, and product decontamination exceeded that required for shipping. The Np–Pu product solution, containing 5412 g Np and 544 g Pu, was shipped off-site in L-10 shipping containers for eventual purification of the neptunium. (auth)

ENGINEERING

Energy Conversion

2483 (JUL-757-TP) VALID LIMITS OF CENTRAL MODEL CONCEPTION OF Cs-PLASMA IN IONIZED THERMIONIC DIODES. Claassen, H. A.; Helrich, C. S. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Aug 1972. 47p. (In German). Dep. NTIS (U. S. Sales Only).

The physical processes in the low-energy range (below Cs ionization) were investigated within the following limiting values: electrode distance, 0.25 to 5.0 mm; Cs vapor pressure, 0.1 to 10 torr; collector and emitter temperature, 700 to 1000, and 1200 to 2000°K respectively; electron temperature and density, 1500 to 3500°K and 10^{12} to 10^{15} cm^{-3}, respectively; work function, 4.0 to 5.3 eV. A discussion of the following concepts is presented: distribution of translational and excitational energy, relaxation and randomization by collisions, deviation from Maxwell distribution of electrons, quasi-Boltzmann–Saha-equilibrium of excited Cs levels, and reabsorption of lines and diffusion of excited levels. The data are given as diagrams showing the parameters as functions of each other. (GF)

2484 (MLM-1885) DESIGN AND CONSTRUCTION OF A NUCLEAR POWERED MILLIWATT GENERATOR. Birden, J. H.; Jordan, K. C.; Miller, M. L. (Mound Lab., Miamisburg, Ohio). 6 Apr 1973. Contract AT(33-1)-Gen-53. 30p. Dep. NTIS $3.00.

A ^{238}Pu powered thermoelectric milliwatt generator of very rugged design is described. The open circuit voltage is 12 V. With an optimum load of 16,500 ohms, the power output is 2.2 mW at 6 V. The ^{238}Pu source supplies heat to an 1170 junction thermopile made of Tophel Special-Cupron Special wire. A thermopile fabrication technique is described. The multiple hermetically sealed unit is a right cylinder, 2.350 in. (5.969 cm) o.d. × 2.125 in. (5.398 cm) high, which weighs $\frac{3}{4}$ lb (300 g). Only 7.8 mR/h of gamma and 10.9 $n/cm^2/s$ are emitted at the surface. An electrical analogue of the thermal circuit is included. (auth)

2485 (N-72-29034) STUDIES OF THERMIONIC MATERIALS FOR SPACE POWER APPLICATIONS. Summary Report, 1 August 1969–7 December 1970. (Gulf General Atomic, Inc., San Diego, Calif.). 20 Jul 1971. Contract NAS3-8504. 110p. (NASA-CR-72947; GULF-GA-11035). NTIS.

Service life tests of LC-8 and LC-9 carbide-fueled thermionic converters are discussed. Post operational tests of the converters to show emitter diametric change, microstructures of cladding and fuel, and analysis of fuel composition are described. The fabrication and performance of high-temperature thermocouples used in the test procedures are included. (auth)

2486 (N-73-10745) STUDY OF RADIOISOTOPE SAFETY DEVICES FOR ELECTRIC PROPULSION SYSTEM. Volume 1. Summary Report. Bradshaw, G. B.; Homeyer, W. G.; Postula, F. D.; Steeger, E. J. (Gulf General Atomic Co., San Diego, Calif). 6 Oct 1972. Contract NAS2 5891. 25p. (NASA-CR-114505; GULF-GA-A-12242(Vol.1)). NTIS.

A new reference design was prepared for the 5 kW(e) thermionic power supply. The safety equipment in this design is a passive containment system which does not rely on the operation of any mechanisms such as a launch escape rocket or deployment of parachutes. It includes: (1) a blast shield to protect against the explosion of the launch vehicle; (2) a combination of refractory thermal insulation and heat storage material to protect against a sustained launch pad fire; (3) a reentry body with a spherical nose and a large conical flare at the aft end to stabilize the reentry attitude and lower the terminal velocity in air; (4) composite graphite thermal protection to sustain the reentry heat pulse; (5) crushable honeycomb behind the nose to limit the deceleration of the radioisotope source due to impact on land at terminal velocity; (6) a double-walled secondary containment vessel surrounding the isotopic capsules; (7) neutron shielding to reduce external dose rates, and (8) an auxiliary cooling system employing redundant heat pipes to remove the radioactive decay heat from the heat source and reject it to the surroundings or to a forced convection loop. (auth)

2487 (N-73-11045) REVISED SOLAR ARRAY SYNTHESIS COMPUTER PROGRAM. Final Report. (Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.). 1 Feb 1970. 45p. (NASA-CR-130109). NTIS.

The Revised Solar Array Synthesis Computer Porgram is described. It is a general-purpose program which computes solar array output characteristics while accounting for the effects of temperature, incidence angle, charged-particle irradiation, and other degradation effects on various solar array configurations in either circular or elliptical orbits. Array configurations may consist of up to 75 solar cell panels arranged in any series-parallel combination not exceeding three series-connected panels in a parallel string and no more than 25 parallel strings in an array. Up to 100 separate solar array current-voltage characteristics, corresponding to 100 equal-time increments during the sunlight illuminated portion of an orbit or any 100 user-specified combinations of incidence angle and temperature, can be computed and printed out during one complete computer execution. Individual panel incidence angles may be computed and printed out at the user's option. (auth)

2488 (NYO-3605-4) THEORETICAL-DENSITY INTEGRALLY BONDED THERMOELEMENTS. Summary Report, September 1, 1965–August 31, 1966. Hemmat, N.; Weinstein, M. (Tyco Labs., Inc., Waltham, Mass.). 1966. Contract AT-(30-1)-3605. 104p. Dep. NTIS $7.25.

Declassified 13 Apr 1973.

A technique utilizing ultrasonic agitation of a solidifying melt has been developed for the preparation of thermoelectric materials. Specifically, n-type PbI_2 doped PbTe and p-type $Pb_{0.7}Sn_{0.3}Te$, which exhibit high electrical efficiencies along with exceptional mechanical stabilities have been prepared. To accomplish this, a carbon concentrator crucible assembly has been designed which greatly facilitates materials preparation. Over 200 experimental casting runs have been carried out during this period. A new 2000 watt ultrasonic casting setup capable of producing ingots up to $2\frac{3}{4}$ in. in diameter and 2 in. long has been constructed and made operational. The n-type material exhibits a higher integrated α^2/ρ factor than commercially available material for the temperature range (25 to 500°C). The p-type material exhibits an integrated α^2/ρ factor comparable to that of the commercially available material over the temperature range of interest. Thermoelements with uniform dimensions were prepared from these fine-grained ingots by conventional machining operations. In particular, it was shown that cylindrical shapes could be produced to tolerances of ±0.0005 in. using conventional hole saws, and the material could be turned on a lathe using normal hardened carbon steel tools. Bonding of ultrasonically prepared fine-grained thermoelectric materials to pure Fe electrodes was accomplished by a diffusion bonding process. Typical contact resistivities of 30 $\mu\Omega$ cm^2 for n-type and 50 $\mu\Omega$ cm^2 for p-type were produced. Specific runs indicated that it should be possible to obtain resistivities of less than 10 $\mu\Omega$ cm^2 for both p- and n-type material by the diffusion process. (auth)

2489 (ORNL-TM-4012) TEST OF A COMBINED HEAT PIPE-THERMOELECTRIC MODULE. Lloyd, D. B. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 56p. Dep. NTIS $5.00.

A test was conducted on a heat pipe and thermoelectric module assembly to determine the performance characteristics of the combined system. The unit was built according to the ORNL reference design which was established to serve as the basis for a technology evaluation in the Isotope Kilowatt Program. The thermoelectric module was designed and fabricated by the 3M Company, and the heat pipe was designed and built by ORNL. Performance characteristics of the system were determined. The thermal efficiency varied from 7.2% at the beginning of the test to 5.1% at the end of the test. Because the loss in performance represents about 30% of the output, the module is not recommended for long-term use. (auth)

2490 (SFB-MHD-6) ANALYTICAL STUDY OF UNCOMPENSATED DC MHD CONVERTERS WITH REGARD TO THE LONGITUDINAL END EFFECT. Schulz, T. (Technische Universitaet, Berlin (West Germany)). Jun 1972. 36p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

The theoretical investigation of dc MHD converters, including armature reaction, without secondary field compensation is described. Likewise, there are considered the electric backpaths or shunts across the outside regions of the working fluid (longitudinal ends). They cause, in addition to the well-known losses in these regions, detrimental effects in the converter section. The problem is reduced to an electromagnetic one because the hydrodynamic effects such as the influence of the velocity profile are neglected. The electromagnetic quantities in the MHD channel were calculated. For magnetic Reynolds numbers $R_M > 1$ there are strong irregularities of the field and current densities along the channel (high concentrations at the fluid exit). The resultant values of power and efficiency are less favorable, compared with an ideal converter. They are plotted and discussed in detail. (auth)

2491 (SFB-MHD-7) COMPARISON OF THE LONGITUDINAL END EFFECTS OF CONSTANT AND TRAVELING FIELD MHD CONVERTERS. Schulz, T. (Technische Universitaet, Berlin (West Germany)). Jun 1972. 29p. (In German). Dep NTIS (U. S. Sales Only) $3.50.

Constant field (dc) and traveling field (ac) MHD converters may often be considered under equal idealizations. If for example the hydrodynamic effects are neglected and the iron inductors assumed to have an infinite magnetic conductivity, the electromagnetic quantities can be determined in a straightforward manner from the basic electrodynamic equations. This has been done for the magnetic flux and the electric current densities in the channel respectively with due regard for armature reaction including the finite length of the converter. The calculations for both converter types are analogous in many ways. Longitudinal end effects are referred to physical reasons of the same kind, which lead to similar assumptions for the calculations. The results, which naturally are different, are briefly discussed and compared. The electromagnetic longitudinal end effects of MHD converters are discussed in an optimal uniform manner in order to contribute to a better understanding of the results obtained. (auth)

2492 (TID-3335) CARDIAC PACEMAKERS AND MECHANICAL HEARTS. A Bibliography of Radioisotope Power Sources. (Technical Information Center (AEC), Oak Ridge, Tenn.). Apr 1973. 45p. Dep. NTIS.

References to 176 publications that have appeared in NSA Vol. 21 (1967) through Issue 5 of Vol. 27 (March 15, 1973) are presented. The NSA subject indexing is displayed under each citation to provide information on the contents of the document. Corporate author, personal author, report number and availability, and subject indexes are provided. (TFD)

2493 MHD GENERATORS: A STEP TOWARDS THE POWER SUPPLY OF TOMORROW. Hanselmann, G.; Zeller, R. M. A. N. (Maschinenfabrik Augsburg-Nuernberg) Forschen, Planen, Bauen; No. 2, 64-67(1971). (In German).

An MHD generator is being developed by a joint study team of MAN and the IPP which is intended to be used for short-time power supply on an economic basis. During the first stage of development, the generator will reach a capacity of 10 MW and an operating time of 10 sec. The physical principles and technical characteristics of a prototype MHD generator are described. (GF)

2494 IMPROVEMENTS IN OR RELATING TO THERMOELECTRIC UNITS. Penn, A. W.; Neighbour, F. (to United Kingdom Atomic Energy Authority). British Patent 1,303,833. 24 Jan 1973. Filed date 30 Jan 1970. 6p.

An improved method is described for connecting electrical leads to a thermoelectric unit comprising an assembly of thermoelectric elements. Secured to a side of the unit is an electrically conducting member, separated from the unit by insulating material, with one face flush with the faces of the thermoelectric elements at one end of the unit, forming a conducting bridge from the face of the member to an end face of one of the thermoelectric elements. Preferably the constructional arrangement is to connect together pairs of thermoelectric elements as a series of thermocouples in a modular unit. The unit is particularly suitable for incorporation in a cardiac pacemaker battery. In this case the conducting bridges are preferably comprised of Au deposited by vacuum evaporation. (UK)

2495 SATELLITE POWER STATIONS: A NEW SOURCE OF ENERGY. Brown, W. C. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 3, 39-47(Mar 1973).

The feasibility of using solar cells located in space to convert solar energy to dc power which would be converted to microwave power is examined. The microwave energy would be beamed to the surface of the earth and there converted back into dc power. Studies indicate that the method is technically feasible. This Satellite Solar Power System (SSPS) is looked upon as a pollution-free resource-conserving approach which could be used to solve the energy problem in the future. The overall SSPS is described including the photovoltaic cell array, microwave power transmission system, dc-to-microwave power converter, and the microwave power-to-dc converter located on earth. Projected system costs are analyzed. It is concluded that study of the system should continue with the hope that this system with its inexhaustible power source may become cost competitive with other energy conversion methods. (LCL)

2496 EMISSION INSTABILITY OF THERMIONIC CONVERTERS. Abramov, Yu. Yu.; Vedenov, A. A.; Gladush, G. G. (Inst. of Atomic Energy, Moscow). Energy Convers.; 13: No. 2, 49-51(Apr 1973).

It is stated that thermionic converters may become unstable if the operating point of the converter is on the negative slope of the emission S-curve. The final stationary states in which this instability may occur have been investigated (Abramov et al., Theses of XIV All Union Emission Electronics Conference, Tashkent (USSR), 1970). It was found that very inhomogeneous temperature profiles may exist along the emitter. In previous publications the thermal flux from the heat source to the emitter was assumed to be homogeneous. However, if the input thermal flux is not homogeneous, only a certain part of the emitter may be in the stable region, while the other part is not. This case, which is of practical importance, is investigated theoretically. (UK)

2497 SPATIALLY DEPENDENT ELECTRON RELAXATION NEAR A THERMIONIC EMITTING ELECTRODE. Wu, F. T.; Shaw, D. T. (State Univ. of New York, Buffalo). Energy Convers.; 13: No. 2, 41-47(Apr 1973).

The spatially dependent relaxation phenomena in thermionic converters are investigated by a solution of the Boltzmann equation for free electrons and the rate equations for bound electronic states. The analysis given shows that the electron distribution function during the relaxation can be described by two Maxwellian groups which eventually merge into one Maxwellian function. The rate of Maxwellization depends on electron–electron Coulomb and electron-neutral inelastic collision frequencies and is strongly coupled to the rate of relaxation of the bound-electron population toward Boltzmann equilibrium. Good agreement is found between the present theory and the available experimental data measured by the use of probe and spectroscopic techniques. (auth)

2498 RADIOISOTOPE MEANS. DesChamps, N. H.; Fink, C. R.; Sullivan, J. J. (To Sanders Nuclear Corp.). U. S. Patent 3,728,160. 17 Apr 1973. Filed date 19 Aug 1968. 8p.

A radioisotope support structure with a fuel capsule defining a first and a second end preferably with a foil insulation surrounding the capsule and first and second insulating end sections adjacent to the first and second capsule ends respectively is described. Methods are provided to force the end sections toward the capsule to firmly support the capsule in a fixed position with respect to the end sections. First and second end caps are interposed between the capsule and the first and second end sections respectively to distribute a pressure load on the end sections and preferably a two-part housing encloses the fuel capsule and insulation with sufficient space therein to mount means for utilizing heat generated by the fuel capsule. In the preferred embodiment, thermoelectric means are assembled within the housing to convert heat generated by the fuel capsule into electrical energy whereby the assembly provides an efficient low-weight high-wattage output generator. In some cases, the foil insulation is omitted or used as a heat sink means. (Official Gazette)

Facilities and Equipment

Refer also to abstracts 3125 and 4966.

2499 (NVO-38-29(Suppl.1)) VERTICAL HOLE DEVELOPMENT STUDY. Supplement No. 1. Grovenburg, W. W.; Walker, J. A. (Fenix and Scisson, Inc., Las Vegas, Nev.). Apr 1973. Contract AT(26-1)-38. 48p. Dep. NTIS $5.45.

A field-test drilling program was performed during the drilling program of Hole U-20Y at the Nevada Test Site in 1971 in order to check the findings of a vertical-hole development study completed earlier. An analysis of the data collected from the test drilling program and an evaluation of the new concepts developed in the vertical-hole development study are presented. The conclusions and recommendations in this report support those in the vertical-hole development study. Specifically, increased drilling rates can be realized by partially enclosing all the cutters and reducing the number of cutters on all bits larger than 72 in. in diameter. (auth)

2500 (RD/B/N-2091) PROGRAM FOR THE ON-LINE PROCESSING OF DATA FROM AUTOMATIC GAS ANALYSIS EQUIPMENT USING A PDP 8/I COMPUTER. Russell, R. D. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Aug 1972. 152p. Dep. NTIS (U. S. Sales Only) $9.75.

A description is given of the computer program which controls the PDP 8/I-based on-line computer system developed to process the data generated by the automatic experimental rigs in the BNL γ-irradiation facility for studying flowing gas reactions. The program is written in the PAL III Symbolic Assemblier Language and is of modular design so that additions to or modifications of the program can be made with the minimum of program rewriting. It is responsible for time keeping, organizing the data collection, sorting the relevant data, and calculating and printing

the answers in useful units, all in real time. It also translates the paper tape produced by the Dataprint unit attached to a Varian MAT CH7 mass spectrometer into standard teletype code. The program has been successfully operated for several months and has shown that the system is capable of increasing the accuracy of data obtained from the experimental rigs. (auth)

2501 MEASUREMENT OF THERMAL STRESSES IN HIGH-TEMPERATURE SODIUM ENVIRONMENTS. Takei, A.; Yamamoto, N. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Hihakai Kensa; 21: No. 11, 658-661(Nov 1972). (In Japanese).

Because of the high coefficient of heat-transfer of liquid sodium, structures may be subjected to high transient thermal stresses. The purpose of this experiment is to investigate the method for measuring the transient thermal stresses with strain gages in the liquid sodium. Thermal stresses were produced by immersing a hollow cylinder into the high-temperature liquid sodium. Thermal stresses in axial and circumferential directions on the surface of the cylinder were measured with weldable strain gages which are considered corrosion-proof against the liquid sodium. Thermal stresses measured by strain gages coincided well with the values calculated from temperature distribution. The result of corrosion test of weldable strain gages in the liquid sodium showed that no corrosive damage of the gages occurred in the short time experiment for the thermal stress measurement. (auth)

2502 IMPROVEMENTS IN AND RELATING TO WASHERS. Thomas, S. N. G. (to Whessoe Ltd.). British Patent 1,304,952. 31 Jan 1973. Filed date 5 Jun 1970. 2p.

Reference is made to improvements in sealing washers. The washer described consists of an imperforate annular member with a frusto-conical flange of constant thickness surrounding the aperture. (UK)

2503 ANALYSIS OF BRANCH PIPE STRESS. Iwasaki, T.; Shimizu, T. (Hitachi Ltd., Ibaraki, Japan). Hitachi Hyoron; 54: No. 12, 1053-1058(Dec 1972). (In Japanese).

Stress and deformation behavior of a branch pipe, one of the typical piping elements, under internal pressure, axial compression and external moment was studied by experimental analyses. The values were compared with those obtained by the finite element method. The comparison revealed the following: stress and deformation of a branch pipe can be calculated by using the equations of the USAS, B 31.7 code and the results of this study; it is unreasonable to determine that stress and deflection indices are constant since these indices vary with their diameter ratio d/D; and stresses calculated by the finite element method are in good agreement with those obtained in the experiments. (auth)

2504 COMPUTER FOR THE ELASTIC ANALYSIS OF PRESSURE VESSELS. Griffin, D. S. (Bettis Atomic Power Lab., West Mifflin, PA). pp 668-688 of Pressure Vessels and Piping: Design and Analysis. Vol. I. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

The development of computer programs for the elastic analysis of pressure vessels has been rapid. It is now possible to solve an impressive array of problems in complex geometries and with nonuniform loading conditions that were undreamed of fifteen years ago. Types of problems which can be solved include thin shells of revolution, two and three dimensional problems such as determining the axisymmetric stress distribution in thick irregularly shaped sections, bodies of revolution with nonsymmetric loads, and cylinder-to-cylinder intersections. Only a few of the programs that have been written are available to the general public and there is no guarantee that they are completely debugged. The user must usually expend considerable effort and exercise good judgement based on his knowledge of the basic numerical methods. Difficulty is often encountered in getting a program running on another computer even though it is written in a standard "compatible" language. Some of the programs are user-oriented, but many are not. The input may be long and tedious, requiring the user to write his own automated input program, and the output may be just voluminous pages of numbers. There is no reliable way of predicting the accuracy of the solution for a given problem, and accuracies inferred from comparisons for simple problems can be misleading. In spite of all these difficulties, the computer has given new insight for the design of pressure vessels. With a knowledge of the detailed stress distribution it becomes possible to optimize a design by adding or subtracting metal at appropriate locations. And the calculative speed allows the rapid comparison of many alternate configurations. Used properly, the new computer programs will allow the development of more realistic and reliable pressure-vessel design criteria at much lower cost than would be required for experimentally developed criteria. (auth)

2505 HIGH FLOW RATE SIZE SELECTIVE ENVIRONMENTAL SAMPLER THAT CONFORMS TO THE LUNG MODEL PROPOSED BY THE I.C.R.P. TASK GROUP ON LUNG DYNAMICS. Stevens, D. C.; Churchill, W. L. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Aerosol Sci.; 4: No. 2, 85-91(Mar 1973).

A high flow rate (35 $l.min^{-1}$) size selective dust sampler is described that has a particle size deposition curve nearly identical to that proposed for the pulmonary compartment of the lung by the I.C.R.P. Task Group on Lung Dynamics (1966). The sampler is a scaled up version of a 2 $l.min^{-1}$ personal sampler previously described by Stevens and Stephenson (J. Aerosol Science; 3:15 (1972)). The particle size deposition curve of the high flow rate sampler is given and the method of calibration using monodisperse polystyrene particles is described. The results of the measurement of airborne radioactive material by the sampler in a decontamination area are reported to illustrate the type of information that can be obtained. The design of the sampler allows a considerable amount of flexibility in the choice of separation characteristics, and it is believed that the sampler could be modified to conform to any future changes in lung model deposition curves. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 2621 and 4533.

2506 (DSR-73645-80) STUDY OF POST CRITICAL HEAT FLUX HEAT TRANSFER IN A FORCED CONVECTION SYSTEM. Plummer, D. N.; Iloeje, O. C.; Griffith, P.; Rohsenow, W. M. (Massachusetts Inst. of Tech., Cambridge). Mar 1973. 111p.

A transient boiling experiment has been run in such a way that one can acquire data in forced convection film, transition, and nucleate boiling regions for a specified pressure, quality and mass flux. Transient boiling experiments were conducted for water in a 0.492 in. ID Inconel X-750 tube at mass fluxes of 50,000, 100,000 and 250,000 $lbm/hr-ft^2$, quality range of 30 to 100%, and a pressure of 1000 psia. The reduced boiling curves for this data indicated temperature differences at burnout on the order of 100 to 200°F and temperature differences at the minimum ranging from 700 to 1100°F. These results (which are somewhat higher than in other experiments) are felt to be caused by a scale deposit on the test surface. Physical evidence indicates that the test surface became coated with an appreciable scale deposit when subjected to the initial temperatures in excess of 1500°F in a steam atmosphere. It has been found that BWR fuel will normally have scale deposit on the heat transfer surface, and thus the data in this report should be applicable to BWR loss-of-coolant accident evaluation. An empirical correlation was developed for this data for minimum film boiling temperature differences. The correlation was based on Berenson's minimum pool film boiling temperature difference correlation in order to provide a technique for extrapolating to different pressures. The film boiling data was compared against the Groeneveld Correlation and found to be considerably underpredicted by the Groeneveld Correlation. An empirical correction term was developed to use in conjunction with the Groeneveld Correlation to predict the experimental data. A calculation procedure is presented which allows one to predict the heat transfer history of a boiling water reactor in the event of a loss-of-coolant accident. (auth)

2507 (MRR-108) CALCULATION OF MASS FLOW OF COMPRESSIBLE, FRICTION-BURDENED STREAMS: COMPARISON OF THEORY AND EXPERIMENT. Brosche, D. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Aug 1972. 90p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

Calculations of mass flow rates of compressible, friction, one-dimensional, subcritical as well as critical one-phase, two-component flows which occur for example in connection with nonstationary pressure buildup processes in reactor containments (full pressure containments and pressure suppression systems) are presented. By analytical integration of the fluid-dynamic basic equations it was possible to get relatively simple, but very accurate relations for the calculation of the mass flow rates. Hereby the necessary computer running time is small using these relations as subroutines in an appropriate code for the calculation of nonstationary pressure distributions in a reactor containment. Calculated results have been tested with appropriate experimental results, rendering a very good agreement between theory and experiment. (auth)

2508 (ORO-3911-4) INVESTIGATION OF THE DYNAMICS OF NUCLEATE BOILING. Final Report. Saxe, R. F. (North Carolina State Univ., Raleigh). 18 Dec 1972. Contract AT(40-1)-3911. 48p. Dep. NTIS $4.50.

Experimental and theoretical work on the dynamics of boiling in sub-cooled water are presented. The main object of the investigation was to obtain some understanding of the mechanism of sound generation by boiling bubbles and to extrapolate this to the case of boiling in liquid sodium. The work was carried out in water because of the ease of observation and lack of special problems with this medium. (auth)

2509 (RT/ING-(72)19) ADVANCES IN HEAT TRANSFER. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 Oct 1972. 296p. Dep. NTIS (U. S. Sales Only) $17.00.

A collection of papers are presented to give an overall idea of the research work in the heat transfer field performed at the Center for Nuclear Studies, Casaccia (Rome), of the CNEN (National Committee for Nuclear Energy). The papers deal particularly with boiling and two-phase flow heat transfer. Post burnout has been particularly studied. Although relating to different problems, the various researches contribute to form a general picture of two-phase flow phenomenology. (auth)

2510 (WAPD-TM-1080) APACHE: A THREE-DIMENSIONAL FINITE ELEMENT PROGRAM FOR STEADY-STATE OR TRANSIENT HEAT CONDUCTION ANALYSIS. Hutula, D. N.; Wiancko, B. E.; Zeiler, S. M. (Bettis Atomic Power Lab., Pittsburgh, PA). Mar 1973. Contract AT(11-1)-Gen-14. 111p. Dep. NTIS $7.25.

APACHE (A Program for Analysis of Conduction of HEat) is a digital computer program for nonlinear steady-state or transient analysis of heat conduction in three-dimensional solids. The finite element method is used with eight-node tri-linear isoparametric elements. The program, written in FORTRAN IV and COMPASS Assembly Language for the CDC-6600 and CDC-7600 computers, is designed for use with the MATUS (structural analysis) and MESH3D (mesh generator) finite element computer programs. Problems with up to about 4000 nodes can be solved on a 60-bit word length computer with a central memory size of 64K and an extended core size of 512K. (K = 1024). (auth)

2511 SIMULATION OF SODIUM BOILING USING A WATER MODEL: VOIDING AND RE-ENTRY PROCESSES. Playle, T. S. (Central Electricity Generating Board, Berkeley, Eng.). Chem. Eng. Sci.; 28: No. 5, 1199-1211(May 1973).

Experiments are described in which boiling was initiated in uniformly superheated water in tubular and pin-cluster geometries, producing voiding into a sub-cooled plenum. By suitable choice of system temperature and pressure, sodium vapour growth rates and liquid metal boiling characteristics were simulated. The processes of voiding, condensation in the plenum and re-entry were studied as functions of thermal and geometrical conditions. Dispersed two-phase flow regimes and a lack of coherent re-entry were observed in the pin-cluster, contrasting with the single-bubble "chugging" which occurred in tubular geometry. A simple theory for the void growth, in which the vapour energy and liquid momentum equations are coupled, is derived; this gives good agreement both with the present experiments and with other published experimental data for different fluids and geometries. From the observations of the bubble dynamics in the sub-cooled plenum an empirical model of this process is presented which also gives good agreement with experiment over a range of conditions. (auth)

2512 PREVENTION OF CRITICAL WALL TEMPERATURES IN EVAPORATOR TUBES. Ahrnbom, L. (Angpannenfoereningen, Stockholm). VGB Kraftwerkstechnik; 52: No. 4, 326-333(1972). (In German).

The growth of waterside depositions in boiler tubes results in a reduction of the heat transfer. The present investigation is concerned with those factors which influence the growth rate of the deposits and the corresponding drop in temperature up to the critical value. This critical value is determined by the maximum permissible temperature of the pipe wall which will be reached after a certain operating time. Moreover, methods for the control of wall temperatures of boiler tubes during operation, as well as other technical measures, with regard to feedwater treatment are discussed. (GF)

2513 SIMPLE METHOD OF PREDICTING FRICTION FACTORS OF TURBULENT FLOW IN NON-CIRCULAR CHANNELS. Rehme, K. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Heat Mass Transfer; 16: No. 5, 933-950(May 1973).

On the basis of friction factor relationships of a simple model a method was developed that allows the prediction of friction factors for turbulent flow in non-circular channels if the geometry factor of the pressure drop relationship for laminar flow is known. The proposed method of calculation is tested with numerous experimental results for noncircular channels such as triangular shaped ducts, eccentric annuli and rod bundles in hexagonal and square rarays in circular tubes, hexagonal and square channels. The method provides an excellent description of all the experimental data. (auth)

2514 HIGH REYNOLDS NUMBER FLUID DYNAMICS AND HEAT AND MASS TRANSFER IN REAL CONCENTRATED PARTICULATE TWO-PHASE SYSTEMS. Yaron, I.; Gal-Or, B. (Technion Israel Inst. of Tech., Haifa). Int. J. Heat Mass Transfer; 16: No. 5, 887-895(May 1973).

Correlations for high Reynolds number interfacial convective heat and mass transfer and fluid behavior of real (i.e., not extraordinarily purified) concentrated two-phase systems of drops or bubbles are derived. The theoretical results obtained compare favorably with various reported experimental data on separation angles, drag coefficients, and Nusselt numbers. (auth)

2515 ROLE OF EXPERIMENTS IN TWO-PHASE SYSTEMS WITH PARTICULAR REFERENCE TO MEASUREMENT TECHNIQUES. Hewitt, G. F. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 213-238 (Apr 1973).

The use of measurement techniques in two-phase flow systems is reviewed and attempts are made to classify the various techniques according to their relevance in the development of two-phase fluid flow. The types of parameters studied are classified as first order parameters; these are of direct relevance in design and can be divided into primary design factors such as pressure drop and heat transfer coefficient and secondary design factors such as flow distribution and stability; second order parameters: time averaged observations which are not of primary relevance in design but which assist in the development and testing of analytical models of the system may be classified in this category, e.g., liquid film thickness, radial mass flow distribution and particle size; and third order parameters: parameters in which the time-varying nature of the parameter is important are included in this class, e.g., interfacial structure, velocity fluctuations and temperature fluctuations. Measurements of these parameters are aimed at providing a qualitative understanding of the system and in assisting in building up more detailed models. Final sections deal with modelling of two-phase systems and improving their performance. (auth)

2516 TRANSIENT TEMPERATURE DISTRIBUTION IN A SLAB SUBJECTED TO RADIATIVE AND CONVECTIVE HEATING CALCULATED BY VARIATIONAL METHOD. Zyszkowski, W. (Inst. of Nuclear Research, Warsaw). Int. J. Heat Mass Transfer; 16: No. 5, 917-932(May 1973).

The variational approach to the heat conduction phenomenon is considered. The use of the variational principle formulated for the system of equations describing the phenomenon, i.e., for Fourier's law and the law of energy conservation, is discussed. The description of the phenomenon is completed by a balance equation for boundary conditions discussed in the generalized form. This form also makes possible the consideration of nonlinear boundary conditions. The transient, one-dimensional temperature distribution is determined for plates with radiative and convective heat transfer on the boundary. (auth)

2517 INCIPIENT-BOILING SUPERHEAT FOR SODIUM IN TURBULENT CHANNEL FLOW: EFFECTS OF HEAT FLUX AND FLOW RATE. Dwyer, O. E.; Strickland, G.; Kalish, S.; Hlavac, P.; Schoener, G. A. (Brookhaven National Lab., Upton, NY). Int. J. Heat Mass Transfer; 16: No. 5, 971-984(May 1973).

An experimental study was carried out in which the effects of heat flux and velocity on the incipient-boiling superheat were determined for turbulent flow of sodium in an annular channel. The heating surface was polished Type 316 stainless steel having a profilometer roughness of 14 to 18 μin. (rms). The rate of temperature rise of the heating surface was maintained constant in each incipient-boiling run, by gradually increasing the inlet sodium temperature to the test section, while the heat flux on the heater was held constant. In this way, the independent variables of heat flux and rate of temperature rise were separated. For a finite rate of temperature rise, it was found that the greater the heat flux, the greater was the incipient-boiling superheat, other things being equal. It was also found that the greater the rate of temperature rise, the greater was the effect of heat flux. The flux was varied over the range 25,000 to 300,000 Btu/hft^2. In general, agreement with published results of previous investigators, the incipient-boiling superheat was found to have a strong dependence on the flow rate, falling off exponentially as the flow rate was increased. The axial location of boiling inception was determined by means of a series of voltage taps spaced along the outer wall of the test section. The results presented represent superheat values for, and nucleations at, the upper end of the heater, or at the highest heating-surface temperature in the test section channel. (auth)

Materials Testing

2518 (EUR-4750) PROCEEDINGS OF AN INFORMATION EXCHANGE MEETING ON "EXPERIMENTAL INVESTIGATION

AND SAFETY ASPECTS OF PCRV'S." Benzler, H. (Comp.). (European Communities, Luxembourg. Commission). Dec 1972. 81p. (In English and French). (CONF-701207-).

From meeting on prestressed concrete vessels for nuclear reactors; Delft, Netherlands (4 Dec 1970).

Nine papers at the meeting on testing of models of prestressed concrete pressure vessels are presented. (TFD)

2519 (ORNL-TM-4107) ANALYSIS OF REFLECTION TYPE COILS FOR EDDY-CURRENT TESTING. Dodd, C. V.; Cheng, C. C.; Simpson, W. A.; Deeds, D. A.; Smith, J. H. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405 eng-26. 211p. Dep. NTIS $12.75.

A theoretical analysis and computer programs for reflection type coils above multiple layered conductors are described. The performance of the coils when connected to phase-sensitive eddy-current instrumentation can be evaluated. The programs are written in both BASIC and FORTRAN for timesharing on the PDP-10 to calculate the effects of defects or variations in either conductivity or thickness for multiple conductors, all in the presence of lift-off variations. In addition, program options are included that allow the study of the design of the coil, the effects of small variations or drifts of all the coil, conductor and instrument parameters, and the effects of the instrument output and input impedance on the problem. Examples are given of the use of the programs for the design of eddy-current tests with reflection type coils. Application of these techniques allow optimum design of eddy-current tests using probe coils without the necessity of expensive trial and error experiments and fabrication. These programs can be applied to the solution of many inspection problems involving reactor fuels and materials. (auth)

2520 DIMENSIONING REACTOR FUEL SPECIMENS FROM THERMAL-NEUTRON RADIOGRAPHS. Cutforth, D. C. (Argonne National Lab., Idaho Falls, ID). Nucl. Technol.; 18: No. 1, 67-70(Apr 1973).

Increasing emphasis is being placed on the quantitative aspects of neutron radiography as an aid in characterizing reactor fuel specimens nondestructively. In general, precise dimensioning from radiographs requires some aid to remove subjectivity from film interpretation; photographic image enhancement was the aid used in this study. The fundamental limitation in determining physical dimensions from radiographs is shown to be related to the ability of the neutrons in the inspection beam to penetrate the samples. Neutron penetration is dependent on parameters other than physical size, so it is reasonable to expect differences between physical dimensions and dimensions derived from radiographs. (auth)

2521 THICKNESS MEASUREMENTS USING EDDY CURRENT TECHNIQUES. Dodd, C. V.; Simpson, W. A. Jr. (Oak Ridge National Lab., TN). Mater. Eval.; 31: No. 5, 73-79; 84(May 1973).

Eddy currents have been used for many years to measure the thickness of a single conductor and the thickness of one conductor clad on another. By performing a computer analysis of the problem, the optimum conditions for performing such measurements have been determined. Effects of varying thickness, frequency, coil size, conductivity, lift-off (or coil-to-conductor spacing), and coil resistance are discussed. The use of a phase-sensitive, eddy current instrument in performing thickness and clad thickness measurements is emphasized. (auth)

2522 NDT FOR NUCLEAR POWER: 1973. Knight, S. R. (Energy Inc., Idaho Falls, ID). Mater. Eval.; 31: No. 5, 19A-24A (May 1973).

The use of nondestructive testing in nuclear power quality assurance is briefly discussed. Emphasis is placed on the importance of testing rather than methods. (TFD)

2523 IRRADIATION ROOM FOR RADIOGRAPHY. Nojiri, T.; Takishima, N. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). Kanagawa-ken Kogyo Shikenjo Kenkyu Hokoku; No. 33, 49-53(Jan 1972). (In Japanese).

An irradiation room for radiography at Radioisotope Research Section, the Industrial Research Institute of Kanagawa Prefecture, was completed in April, 1971. The room is 8m × 7m wide, and has a front room of 11 × 3.5m of labyrinth type. Shielding walls are made of normal concrete of 140 cm and 120 cm thick. A large 300 Ci ^{60}Co source was installed in the room, and shielded with lead and tungsten. The source can irradiate a range of 40° in vertical direction, and 60° fixed and 360° panoramic irradiation in horizontal direction. Sufficient consideration is taken for safety and failure protection, being equipped with shutters, door-locks, indicator lamps, radiation monitors, and industrial TV. Results of dose rate measurement at main spots around the source and of γ-ray leakage dose measurement outside of the wall, are described. Doses at the boundary of the operation room never exceed 10 mR after a week continuous operation in the panoramic irradiation mode. (JA)

2524 EXPERIENCE IN THE APPLICATION OF FAST NEUTRON RADIOGRAPHY TO IMAGING BIOLOGICAL SYSTEMS. Bull, S. R.; Ingwersen, J.; Slaten, N. (Univ. of Missouri, Columbia). Proc. Jap. Conf. Radioisotop.; No. 10, 230-233(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A fast neutron radiography facility was developed using a small accelerator to produce fast neutrons (14.4-MeV) by the T(d,n) reaction. The beam of fast neutrons was extracted through a divergent collimator oriented at an angle of 65° with the accelerator axis. It provides a ten-inch-square radiography area, 22 inches from a neutron source. The collimator was not oriented along the accelerator axis, because x-rays are produced and advance along the axis. A fast neutron monitor was installed to provide on-line, continuous monitoring of an integrated fast neutron dose at the object position. This was calibrated with a small Cu foil placed at the radiograph position by making use of the 11.5-MeV threshold (n,2n) reaction and counting annihilation gamma from the resulting activation. A tissue-equivalent dosimeter was also used for the secondary measurement of the integrated dose delivered to each specimen being radiographed. Radiographs of control plexiglass and biological specimens were taken; e.g., human teeth, thyroid phantom, mouse, and leg and paw of a cat. A computer-aided image analysis routine that is routinely used for the enhancement of x-rays was applied to the neutron radiographs. Refinement by the image-enhancement procedure would contribute to the reduction of dose level required. The fast neutron radiographs are characteristically low in contrast; they are similar to the often used radioisotope scan in nuclear medicine. Continued development of detection systems, neutron sources, and image interpretation will increase usefulness of the fast neutron radiography, but the technique remains impractical for immediate application to clinical diagnosis. (Japan)

2525 ESTIMATION OF SPOT IMAGE INTENSITY DISTRIBUTION IN THE RECEIVING SYSTEM IN GAMMA RADIOGRAPHY. Nojiri, T. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). Kanagawa-ken Kogyo Shikenjo Kenkyu Hokoku; No. 33, 41-47(Jan 1972). (In Japanese).

X-ray film, as a receiving system in γ-ray radiography, generally utilizes sensitivity based on electrons generated by absorbing γ-rays. The film density and distribution function of spot image intensity can be estimated by calculating the amount of secondary electrons and determining absorption through the emulsion. Assume that γ-rays of E MeV impinges on a lead foil of T μm thick, interacts with the electrons of lead atoms at Z μm depth, and makes compton electrons come out in φ direction. These electrons decrease or are less-energized in lead and emulsions. Calculation was done, assuming that the density is proportional to electron reduction in the emulsion. An equation for calculating energy of the Compton scattering electrons is indicated, and various calculated results are shown in graphs. There are many problems in determining film sensitivity in such simple assumption. However, useful data seem to be obtained if a calculating system is selected so that the sensitivity and distribution approach close to measured values. (JA)

2526 STUDY OF SCATTERED RADIATION FROM AN OBJECT IN γ-RAY RADIOGRAPHY. Nojiri, T. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama, Japan). Kanagawa-ken Kogyo Shikenjo Kenkyu Hokoku; No. 33, 23-27(Jan 1972). (In Japanese).

Scattering radiation from objects is generally one of the primary sources which deteriorates image quality in γ-ray radiography. At first, the relation of apparent γ-ray absorption coefficient and film density was analyzed. Condition of the large apparent absorption coefficient considering scattering is required in order to increase film density difference ΔD. A method to greatly utilize direct radiation in a slit-shaped irradiation field by using randomness of scattering direction is discussed. Detection sensitivity and film density were determined with a penetrameter and ^{60}Co, adjusting the irradiation field with the double slit of lead over 50 mm thick. It was found that upgrading of the penetrameter sensitivity is possible in considerably thick objects if a narrow slit is used. For example, at the distance of 1 m and with 10 Ci ^{60}Co, an area of 10 cm width of 10 cm thick iron object can be inspected in 28 h at the detection sensitivity of over 0.6%. (JA)

2527 INFORMATIONAL QUALITY INDEX FOR HIGH-ENERGY RADIOGRAPHY. Panaitescu, I. (Inst. for Atomic Physics, Bucharest). pp 347-353 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The physical significance and application of an image quality index for expressing the performance of a radiographic system in terms of the detectability of flaws are discussed. (WHK)

2528 USE OF THE EXTRACTED ELECTRON BEAM FROM A BETATRON FOR DEFECTOSCOPY. Kononov, B. A. (Tomsk Polytechnic Inst., USSR). pp 355-370 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

A method and apparatus were developed for the nondestructive testing of machine parts and other materials using a 0.5 to 30 MeV electron beam from a betatron. The method is particularly recommended for laminated parts, light materials, and reinforced metals. (KSW)

2529 PHYSICAL BASES OF RADIATION NONDESTRUCTIVE TESTING BY BETATRON BREMSSTRAHLUNG OF OBJECTS WITH A NONHOMOGENEOUS STRUCTURE. Vorob'ev, V. A. pp 383-395 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Methods of nondestructive testing of materials of nonhomogeneous composition using bremsstrahlung from a betatron are analytically treated. Radiographic control of the compactness of concrete or of iron-reinforced concrete construction is examined mathematically for illustration. (KSW)

2530 AUTOMATIC INSPECTION OF NUCLEAR FUEL ELEMENT CANS. Metrol. Insp.; 5: No. 2, 5-8(Apr 1973).

A device that combines the production of finned stainless steel fuel cans by tangential form grinding and automatic ultrasonic thickness gauging is described. (UK)

2531 INTRODUCTION TO ELECTROMAGNETIC NONDESTRUCTIVE TEST METHODS. Libby, H. L. New York; John Wiley and Sons, Inc. (1971). 377p.

Electromagnetic nondestructive test methods are discussed. These methods are widely used in the metals industry to solve a variety of materials and product evaluation problems. Electromagnetic testing is defined to be any test or measurement method for inspecting or evaluating materials or products which does not adversely affect their serviceability and which uses the effects of electromagnetic induction, electromagnetic fields, or varying currents for probing, measuring, or inspecting. This method of testing is discussed in chapters on the following: introduction, basic principles, instrumentation, communication system aspects, electromagnetic fields and flow of currents, sensing coils and the formation of signals, multifrequency methods, pulse methods, special applications, and development aids. (RCK)

Nuclear Explosions

Refer also to abstracts 2586, 2608, 2612, 2615, 2700, 3017, 3405, 3406, 3537–3539, 4545, 4570, 4608, and 4994.

2532 (JAB-99-103) TIME DOMAIN ANALYSIS OF STRUCTURE MOTIONS. Raggett, J. D. (Blume (John A.) and Associates Research Div., San Francisco, Calif.). Apr 1973. Contract AT(26-1)-99. 45p. Dep. NTIS $4.00.

An analysis procedure is presented to obtain linear dynamic response characteristics from an input-output pair of time histories. The modal responses are isolated and separated from the total response by a filtering scheme presented. To each modal response a theoretical single-degree-of-freedom oscillator response is fitted in a least squares sense as a function of period, damping ratio, scale factor, initial displacement, and initial velocity. Response characteristics of the best-fit oscillator must then equal the response characteristics of the mode isolated. Four example analyses are presented to demonstrate the capabilities of this procedure in analyzing ground motion excited vibrations, forced vibrations, and free vibrations. (auth)

2533 (UCID-16148) APPLICATION OF NUMERICAL MODELING TECHNIQUES TO PROBLEMS IN EXPLOSIVE EXCAVATION ENGINEERING. Burton, D. E.; Bryan, J. B. (California Univ., Livermore. Lawrence Livermore Lab.). Nov 1972. Contract W-7405-eng-48. 21p. (CONF-721109-21). Dep. NTIS $3.25.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

Over a period of about ten years, the Lawrence Livermore Laboratory has developed several one- and two-dimensional hydrodynamic codes. Using finite-difference techniques, these codes model the effects of shock wave propagation through media for which the constitutive relations are known. Elastic, plastic, inelastic, gaseous, and fluid behavior of the material is taken into account. These codes were developed primarily as research tools and have not been extensively utilized in explosive excavation engineering applications. The types of information which the codes can provide, their applications, and a few of the problem areas in nuclear or chemical explosive excavation to which the codes can be economically applied are discussed. The "hydro" codes offer large potential savings in many situations. In studying concepts such as controlled or directed blasting, the need for extensive and costly field programs can be greatly reduced through preliminary modeling studies. (TFD)

2534 (UCID-16243) PERMEABILITY OF MESAVERDE SANDSTONE SAMPLES: PROJECT RULISON. Quong, R. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Mar 1972. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

The permeability (K) of preshot Rulison samples was measured as a function of net confining pressure. These sandstone samples represent gas-bearing sands located at a depth of ~8400 ft. The measurements were made for comparative studies with measurements and calculations from other sources. (auth)

2535 (UCRL-51349) COMPARISON OF SHOCK EFFECTS IN GRANITIC ROCK RECOVERED FROM THE MONIQUE EVENT, ALGERIA, AND THE PILEDRIVER EVENT, NEVADA TEST SITE. Borg, I. Y. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Mar 1973. Contract W-7405-eng-48. 17p. Dep. NTIS $3.00.

Shocked granite samples from the Monique Event in the Hoggar Mountains, Sahara, have been microscopically examined and compared with fractured granodiorite recovered from postshot cores at the Piledriver site, Nevada Test Site. One sample, nominally from the pulverized zone adjacent to the Monique cavity wall, is estimated to have been shocked to 155 ± 35 kbar pressure and to have been recovered a few meters or 1.03 ± 0.02 r_c from the shot point. These estimates are based on microscopic evidence of particular types of plasticity in mineral species. The second sample, nominally in the fractured zone, is estimated by the same criteria to have been shocked to 35 ± 5 kbar and recovered 1.45 ± 0.08 r_c from the shot point. From all indications the dimensions of the pulverized and fractured zones measured at both the Monique and Piledriver sites are comparable when scaled to cavity radius (r_c) rather than to yield ($W^{\frac{1}{3}}$). The Higgins and Butkovich equation is equally successful in predicting r_c for the two events, which belies the common impression that Hoggar cavities are always smaller than those produced by comparable U. S. explosions. From the point of view of phenomonology, the Monique and Piledriver events differ in two, possibly related, respects. A zone of residual stresses exists beyond the fracture zone at Monique and was not recognized at Piledriver in postshot drilling operations. Secondly, on a microscopic level samples shocked ostensively to the same pressures contain a slightly more pervasive and closely spaced network of fractures at the Monique site than at Piledriver. It is proposed that some or all of the stored elastic energy, i.e., the residual stress, is of tectonic origin and unique to the Hoggar massifs. It is also suggested that this stress has been released upon shock loading and unloading, thereby augmenting the fracturing which results from the mechanical energy of the explosion. (auth)

2536 (USGS-474-142) HYDRAULIC TESTING AND SAMPLING OF WATER WELL NUMBER 2, PROJECT WAGON WHEEL, SUBLETTE COUNTY, WYOMING. Dinwiddie, G. A. (Geological Survey, Lakewood, Colo. (USA)). Apr 1973. Contract AT(29-1)-474. 37p. Dep. NTIS $4.00.

Wagon Wheel Water Well No. 2 was drilled to obtain hydraulic data at the site of Project Wagon Wheel, a Plowshare Project in the Green River basin of Sublette County, Wyoming. Two intervals in the 5,200-foot (1,585.0-meter) deep hole were hydraulically tested and samples of water were obtained. Results of testing the upper interval, near the 2,300-foot (700-meter) level, indicate that transmissivity is about 9 cubic meters per day per meter (710 gallons per day per foot) and that the static water level, after correction for density, is 30.3 meters (99.4 feet) below land surface. Examination of chemical analysis indicates that water from this upper interval is fresh. Results of testing the lower interval, near the 5,000-foot (1,530-meter) level, indicate that transmissivity is about 7×10^{-2} cubic meters per day per meter (5.4 gallons per day per foot) and that the static water level, after correction for density, is 17.2 meters (56.4 feet) below land surface. Examination of chemical analysis indicates that water from this lower interval is highly saline. Pressure head increases with depth in this hole, indicating the potential for up-

ward movement of fluid. However, the great difference in chemical quality of fluid samples collected from the two tested intervals indicates that significant vertical movement of fluid upward is unlikely in the vicinity of Wagon Wheel Water Well No. 2. (auth)

2537 PROSPECTS FOR ROCKET PROPULSION WITH LASER-INDUCED FUSION MICROEXPLOSIONS. Hyde, R.; Wood, L.; Nuckolls, J. AIAA Paper No. 72-1063. New York; American Institute of Aeronautics and Astronautics (1972). 15p. (CONF-721116-4; UCRL-74218(Rev.2)). $2.00.

From 8th joint propulsion specialist conference; New Orleans, Louisiana, USA (29 Nov 1972).

The basic features and performance potential of the class of specific impulse-maximizing laser-induced fusion microexplosion exoatmospheric propulsion systems are discussed. Considerations in and results of the integrated optimized design of the major components of such a propulsion system are presented, with emphasis on novel features. Technical uncertainties to which system performance is sensitive and present rates of resolution are treated, as well as cost, launch and assembly considerations. The potential applications of a 300 ton propulsion system, capable of applying velocity increments in excess of 1000 mps to ~100 ton payloads, are briefly noted. (auth)

2538 GAS PRODUCTION THROUGH NUCLEAR EXPLOSIONS. Curtis, H. B. (Atomic Energy Commission, Washington, DC). Amer. Gas. Ass. Mon.; 55: No. 3, 10-13(Mar 1973).

The technical and economical feasibility of natural gas production stimulation using nuclear explosions is discussed. The major problem is reported to be public acceptance of the project due to seismic effects and radioactivity in the produced gas. (TFD)

2539 EJECTA FROM A ROW-CHARGE CRATERING EXPLOSION. Vortman, L. J.; Long, J. W. (Sandia Labs., Albuquerque, NM). Nucl. Technol.; 18: No. 3, 286-304(Jun 1973).

Ejecta distribution about a row-charge cratering explosion was analyzed to gain knowledge of ejecta transport and to provide information basic to the construction and checking of a mathematical/physical model. Nine cast-TNT spherical charges spaced equally in a row and buried uniformly deep were detonated simultaneously. Areal distribution and vertical deposition around and within the crater were determined using particulate tracers placed in a grid pattern in five vertical planes within the material to be cratered. The unexpected finding that considerable material near the ends of the row was transported longitudinally toward the opposite end of the row indicates that a two-dimensional model based on the midpoint of a row is overly simplistic for a nine-charge row. Evidence is that longitudinally transported material is derived from two separate sources and is apparently transported by different mechanisms. (auth)

Protective Structures and Equipment

Refer also to abstract 3356.

2540 (ARH-SA-157) PROPOSED FIRE PROTECTION METHOD FOR 234-5 Z BUILDING PLUTONIUM EXHAUST SYSTEMS. Lee, H. A. (Atlantic Richfield Hanford Co., Richland, Wash). Mar 1973. Contract AT(45-0)-2130. 11p. (CONF-730322-1). Dep. NTIS $3.00.

From AEC and Contractor Fire Protection Engineers' Conference; Albuquerque, New Mexico, USA (20 Mar 1973).

The 234-5 Z Building is a three-story structure that was built in 1948. It has been used for plutonium processing and fabrication operations as well as for certain laboratory functions such as research and analytical work in support of plutonium processing. As originally built it had some deficiencies in its fire protection capability when compared to today's standards. Several steps have been taken to correct the situation. The filters of the E-3 and E-4 ventilation system are the last major weak spot in the fire protection of the 234-5 Z Building. Several steps (some of which have been taken or are underway) are recommended to assure adequate fire protection for the E-3 and E-4 exhaust filter systems. (TFD)

Safety Engineering

Refer also to abstracts 3170 and 3473.

Vacuum Engineering

2541 PRODUCTION AND MEASUREMENT OF ULTRA-HIGH VACUUM BELOW 10^{-10} TORR. de Chernatony, L. (Polytechnic, London). Vacuum; 22: No. 12, 635-642(Dec 1972).

Experience on operating two experimental UHV systems down into the 10^{-12} torr region are briefly reviewed. Results of tests are reported on the attainment of a given level of vacuum with a particular concentration distribution when using hot and cold cathode devices, demonstrating the perturbing influence of hot cathode devices at these vacuum levels. Experimental results on system response to the operation of a triode ion pump leads to gassing rates, for baked stainless steel surfaces, of less than 10^{-16} torr l. s^{-1} cm^{-2}. A magnitude, which the volume oriented kinetic model is unable to explain, is in good agreement with a surface oriented model involving permeation and consideration of the state of the surfaces. This approach predicts the attainment of lower pressures, in larger systems, provided the correct processing techniques are adapted. Confirmation is obtained with a 50 l. working volume system, as tested with pump combinations involving sorption, turbomolecular, magnetic ion, and sublimation pumps. Problems due to measurement procedure, and due to insufficient sensitivity of mass spectrometers are emphasized. (auth)

2542 FACTORS LIMITING THE ATTAINMENT OF ULTRA-HIGH VACUUM BELOW 10^{-10} TORR. Carter, G. (Univ. of Salford, Eng.); Armour, D. G.; de Chernatony, L. Vacuum; 22: No. 12, 643-649(Dec 1972).

The present capabilities of ultrahigh vacuum pumping systems are such that the major limitation on the attainment of ultrahigh vacuum is the gas load presented by degassing and permeation of walls and of internal components. Considerable work has been undertaken, theoretically, and experimentally, to illustrate the effects of high temperature bake-out on minimizing outgassing rates but these usually refer to effects at ambient or constant elevated temperature. The present communication analyzes the rate of degassing of components fabricated for example in stainless steel when subjected to time varying heating cycles, in terms of diffusion from the bulk of the solids. It is shown that measurements of degassing rate as a function of increasing temperature can lead to detailed knowledge of the diffusion process which is important in determining the degree of bake-out necessary for individual systems. Experimental measurements on the degassing of insulating and lubricating materials frequently used in ultrahigh vacuum systems (tungsten diselenide, molybdenum disulfide and boron nitride) are also reported and discussed. (auth)

2543 HIGH-VOLTAGE CONDITIONING AT LARGE GAPS IN INDUSTRIAL VACUUM. Steib, G. F. (Univ., Grenoble, France); Moll, E. J. Phys., D (London); 6: No. 2, 243-255(Jan 1973).

The improvement of high-voltage insulation in vacuum by aging the electrodes is well known. This so-called conditioning effect becomes very important if ultrahigh vacuum techniques cannot be employed in systems with large dimensions. For unbaked surfaces this effect allows one to increase the initial field strength by a factor of about 10. In the present paper, the electrode gaps were variable between 15 and 30 cm. For such gaps, the conditioning and also the deconditioning process which occurs when the high voltage is removed have been studied. An attempt has been made to describe these processes mathematically, and to understand the mechanism involved. The results are compatible with the hypothesis that these effects are due to a change in the adsorbed gas layer; that is, a change in the work function of the electrode material. (auth)

ENVIRONMENTAL AND EARTH SCIENCES

2544 PROCEEDINGS OF THE FIFTEENTH CONFERENCE ON GREAT LAKES RESEARCH, MADISON, WISCONSIN, APRIL 5-7, 1972. Ann Arbor, MI; International Association for Great Lakes Research (1972). 774p. (CONF-720451-).

From fifteenth conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972).

Sixty-three papers are included on the biology, chemical limnology, geology, meteorology and hydrology, and physical limnology of the Great Lakes. Eleven papers are within the subject scope of Nuclear Science Abstracts; separate abstracts were prepared for ten. An abstract of one paper appeared previously in NSA Vol. 26 as number 38431. (DEB)

For abstracts of individual papers see: 2171, 2545, 2569, 2575, 2623-2627, and 2972.

2545 BENTHIC MACROFAUNA IN THE COASTAL ZONE OF SOUTHEASTERN LAKE MICHIGAN. Mozley, S. C.; Garcia, L. C. (Univ. of Michigan, Ann Arbor). pp 102-116 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

In July 1970, the first of a continuing series of benthos surveys was conducted in southeastern Lake Michigan in an area centered 16 km south of Benton Harbor. This report contains the species composition and abundances from that survey. The 23 × 11 km area along the shore exhibited a clear gradient in total benthos abundance, which was correlated positively and significantly with depth between 4 and 25 m. Imposed on this gradient was a series of faunal zones characterized by four types of chironomids (4-6 m), Pontoporeia affinis, Sphaerium striatinum and Limnodrilus hoffmeisteri (8-15 m) and Pontoporeia, Stylodrilus heringianus, Sphaerium sp. 1 and S. nitidum (20-25 m). Intermediate depths had mixtures of the animals from adjacent zones. Altogether, 38 taxa were distinguished and only the genus Pisidium was not broken down into species or larval types. Comparisons of the types of chironomids and oligochaetes with other areas in the Great Lakes revealed a mixture of oligotrophic and eutrophic conditions, as defined by indicator species. Application of a standard species diversity index to the samples gave moderate to high values, indicating good quality of the benthic environment. Where low values occurred, they were attributable to severity of the natural environment rather than pollution. (auth)

Minerals and Ores

Refer also to abstract 2657.

2546 (INIS-mf-165/9) PROBLEMS OF THE RAW MATERIAL BASE OF NUCLEAR POWER GENERATION. Pluskal, O.; Novy, P. (Karlova Universita, Prague (Czechoslovakia)). 1970. 15p. (In Czech). INIS.

A review is presented on the raw material base of nuclear power generation in non-socialist countries. A brief outline of the individual types of uranium deposits is given. Uranium deposits in the respective countries are shown in a table (in tons of uranium). Prospects are estimated for the development of survey and mining, mainly in the United States, Canada, France, Australia, and in African and South American localities. (INIS)

2547 (RME-4056) MINERALOGICAL AND GEOLOGICAL INVESTIGATIONS OF THE URANIUM DEPOSITS OF THE WIND RIVER DISTRICT, WYOMING. Coleman, R. G. (Division of Raw Materials (AEC), New York). Jun 1954. 18p. Dep. NTIS $3.00.

A study of the uranium deposits of the Wind River District, Wyoming, was undertaken to determine the relationships between the mineralogy and uranium equilibrium state and the field geology of the deposits. Preliminary laboratory examination of representative samples from the deposits was completed using radiometric and spectrographic methods of analysis before starting the field investigations. Results indicate that the uranium deposits of the Wind River Basin follow a certain sequence according to their relative position with regard to the ground-water table or erosional benches. The analytical and geological data strongly suggest that the cap rock is the source rock for the higher grade mineralized areas. High arsenic content in most of the uranium-bearing cap rock localities strongly suggests a hydrothermal source of the uranium. (auth)

2548 URANIUM AND THORIUM IN PROCESSES OF REGIONAL AND CONTACT METAMORPHISM OF ROCKS. Ermolaev, N. P. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 4, 551-558(Apr 1973). (In Russian).

The main regularities of uranium and thorium distribution and migration in processes of regional and contact metamorphism at progressive and regressive stages are considered. Three types metamorphic processes are distinguished, which differ in the main by the character of radioelement behavior during the Earth crust formation. The temporal relationship of processes of radioelement dispersion and concentration during metamorphism of rocks is analyzed. (auth)

2549 EPISODIC URANIUM-LEAD MODELS AND THE INTERPRETATION OF VARIATIONS IN THE ISOTOPIC COMPOSITION OF LEAD IN ROCKS. Gale, N. H. (Oxford Univ.); Mussett, A. E. Rev. Geophys. Space Phys.; 11: No. 1, 37-86 (Feb 1973).

An investigation is made of the restrictive conditions under which two- and three-stage episodic models lead to rectilinear plots in the isochron, lead-lead, and modified concordia diagrams; the question of the solubility of these models and the possibility of discriminating between them are discussed. It is shown that there are two special three-stage models that lead to rectilinear plots in all diagrams and that one of these models cannot (from uranium-lead data alone) be distinguished from the two-stage model. (DHM)

2550 NUCLEAR PILE CONSTRUCTED BY NATURE ITSELF. Scientists Discovered Traces of a Self-Sustaining Chain Reaction in Gabon. Bruns, K. Welt (Hamburg); No. 255, 28p. (1972). (In German).

A note is given concerning the experimentally detected deviation of the isotopic ratio (0.621-0.640 instead of 0.730% ^{235}U) in uranium ores of the Oklo mines in Gabon. In connection with the chemical composition of the minerals (rare earth elements occurring as fission products) this finding supports the hypothesis of the occurrence of a natural nuclear pile at that place before about 1.7×10^9 years. (GE)

2551 OKLO (GABON) FOSSIL REACTOR. Energ. Nucl. (Paris); 14: No. 5, 376-381(Oct 1972). (In French).

Geological studies of the uraniferous Oklo deposit demonstrated the existence of circumstances having favored a chain nuclear reaction: old deposit having a high concentration of uranium and a large volume; small concentration of neutrophage elements with the presence of water being very likely during the reactive period. Measurements of concentrations of ^{235}U, ^{142}Nd, ^{143}Nd, ^{144}Nd, ^{145}Nd, ^{146}Nd, ^{148}Nd and ^{150}Nd are presented together with measurements of the following isotopic ratios $^{151}Eu/^{153}Eu$, $^{140}Ce/^{142}Ce$, $^{144}Sm/^{147}Sm$ made on samples from the deposit. These measurements confirm this hypothesis. (auth)

2552 REVIEW OF THE FRENCH POSITION CONCERNING ENERGY, METALS, AND ORES IN FRANCE AND HER OVERSEAS TERRITORIES. A6. Uranium. Ann. Mines; No. 8, 23-24(Aug 1972). (In French).

The French production of U ores and concentrates between 1966 and 1971 is given. The world and French positions concerning U ores are examined: prospection, exploitation, concentration, cost, imports and exports. (auth)

2553 EXISTENCE OF A CHAIN FISSION NUCLEAR REACTION IN THE DISTANT PAST IN THE OKLO (GALBON) URANIUM DEPOSIT. Neuilly, M. (CEN de Cadarache, Saint-Paul-les-Durance, France); Bussac, J. ; Vendryes, G.; (and others). Compt. Rend., Ser. D; 275: No. 17, 1847-1849(23 Oct 1972). (In French).

The large abnormalities in the isotopic composition of the Gabon deposit can only be attributed to a self-maintained nuclear chain reaction which occurred naturally in the deposit at a certain period in the distant past. (auth)

2554 TRACE ELEMENT BEHAVIOR DURING THE FORMATION OF THE SKAERGAARD AND KIGLAPAIT INTRUSIONS. Schauwecker, D. S. Madison, WI; Univ. of Wisconsin (1972). 286p. University Microfilms Order No. 72-29, 511.

Thesis (Ph. D.).

Whole rock and plagioclase, olivine, clinopyroxene, apatite, magnetite, and ilmenite mineral separates from the Skaergaard and Kiglapait intrusions have been analysed for the elements antimony, arsenic, barium, bromine, chromium, cobalt, copper, gallium, gold, manganese, nickel, scandium, and zinc. Analysis

was by neutron activation with some use of atomic absorption and flame emission for chemical yield determination. In addition the mathematical analysis also included the elements dysprosium, europium, holmium, lanthanum, lutetium, neodymium, samarium, terbium, and ytterbium. Trace element concentrations from average rocks within a single zone appeared reasonably constant. Concentrations of different zones could be predicted by the logarithmic model or by a quasi-equilibrium model. Success of the predictions depended on knowledge of mineralogy of the zone, the affinity of the trace element for each of the cumulus mineral phases, and the percentage of the rock made up of orthocumulus material (trapped liquid). In general both models gave good predictions for the concentrations of the rare-earth elements, barium, gallium, manganese, scandium, and zinc. The logarithmic model appears to be slightly superior to the quasi-equilibrium model. The other elements gave poor results due to the great affinity for them of unanalyzed minor mineral phases, e.g., the sulfide phase for copper. The model predicts that the Hidden Zone must contain between 40% and 65% of the entire mass of the Skaergaard intrusion. The results indicate that the affinity of a trace element for a cumulus mineral phase may vary with the composition of the given mineral phase. (Diss. Abstr. Int., B)

2555 USLOVIYA OBRAZOVANIYA MESTOROZHDENII URANA V VULKANICHESKIKH DEPRESSIYAKH. (Conditions for the Formation of Uranium Deposits in Volcanic Depressions). Tugarinov, A. I. Moscow; Atomizdat (1972). 312p.

An analysis is made of the geological and physicochemical conditions of the formation of one of the Mo–U ore deposits as an example of uranium deposits in volcanic depressions. It was established that the ore deposits were formed from solutions, the composition of which was accumulated to a certain extent as a result of their reactions with rocks of an andesitebasalt type and the time of a movement along a laminar collector at the bottom part of the depression. On account of oxidation of the sulfides in the bottom strata, these solutions acquired an acidic reaction, and any transport of metals took place in them in a form stable to the acid medium. The cause for a disturbance of the physicochemical equilibria and consequent uranium deposition was the reaction of the ore-bearing solutions with rocks of a liparite composition, a lowering of the pH, and a gradual cooling of the solutions. These changes in turn wrought other changes in pressure, degassing, and mineralization. All of the above steps are examined in detail by the authors. 211 references. (KSW)

2556 URANIUM IN FRANCE. Pons, R. (CEN, Fontenay-aux-Roses, France). Develop. Ind. Sci.; No. 10, 18-21(May 1972). (In French).

The U reserves in France were evaluated in July 1970. Their distribution was analyzed (CEA and private enterprise). Prospecting methods are briefly reviewed; the production of U in 1971 is given together with predictions for 1972. Ore processing plants have been established near the CEA extracting plants. (FR)

2557 DATA CONCERNING REGIONS AS OBJECTS OF URANIUM RESOURCE DEVELOPMENT IN FOREIGN COUNTRIES. Tokyo; Power Reactor and Nuclear Fuel Development Corporation (1972). 91p. (In Japanese).

These data were produced by Resource Division of Power Reactor and Nuclear Fuel Development Corp. as fundamental data for examining concretely measures to develop uranium resources in foreign countries and to import uranium for Japan. The data are results of survey heretofore. As for policy and progress in the state of development of prospecting concerning the uranium resources in each country, possibility of change is expected hereafter, therefore correction and addition will be carried out at every opportunity when information will be available. In the data, communistic countries are excluded. A table showing degree of hopefulness on the viewpoint of geological deposits in each country is given. Political problems in each country are presented also in the table. Canada has the uranium resources of 232,000 tons, and is ranked second in the world. Canadians and foreigners are not discriminated in each state mining law. Japan must examine as rapidly as possible prospecting in Canada. In U. S. A., mining rights can be acquired only by U. S. citizens, accordingly Japan cannot establish her own mining right. Joint prospecting with U. S. mining right owners is mainstay in Japanese activity. Many good deposits were found in Australia, and problems regarding advance of Japan are little, accordingly Australia is most promising. Activity of Japan is welcome in Peru, Nepal, Niger and Central Africa. (JA)

2558 ROLE OF RADIOGENIC HEAT IN THE TOTAL HEAT FLOW IN THE EARTH'S CRUST OF KAMCHATKA. Duchkov, A. D.; Krendelev, F. P.; Puzankov, Yu. M.; Bobrov, V. A. (Inst. of Geology and Geophysics, Novosibrisk, USSR). Dokl. Akad. Nauk SSSR; 207: No. 2, 405-408(11 Nov 1972). (In Russian).

The territory of Kamchatka possesses paradoxical geothermal characteristics, and as an aid to explaining this feature, the role of that heat generated by the decay of natural U, Th, and K in the rocks of the crust was explored. The specific intensity of heat release, A, was calculated to be small for the majority of Kamchatka's rocks, and the radiogenic A of certain regions of Kamchatka was compared with that of Alta-Sayansk. These data on heat flow from the upper mantle indicate that some regions of Kamchatka may be identified as contributing to the anomalous thermal pattern. (KSW)

Radioactive Effluents

Refer also to abstracts 2597, 2609, and 2982.

2559 (BNWL–1464) REVIEW OF STUDIES ON SOIL–WASTE RELATIONSHIPS ON THE HANFORD RESERVATION FROM 1944–1967. Routson, R. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Mar 1973. Contract AT(45-1)-1830. 63p. Dep. NTIS $3.00.

Hanford chemical processing plants have been in operation for more than twenty years, and during this period have disposed large volumes of waste liquids to the Hanford sediments. Because the groundwater and sediments at this major nuclear facility have been closely monitored and investigated, a unique opportunity exists to assess the effects of these disposal practices on the Hanford soil environment. The literature regarding effects of the liquid waste disposal operations at Hanford on the soil environment is summarized. This summary is divided into studies pertaining to: the vadose zone below a depth of twenty feet (lower vadose zone); the saturated zone; and the vadose zone above twenty feet (upper vadose zone). The division is based upon the relative desirability of these three zones for nuclear waste disposal (storage). Liquid nuclear wastes have been safely discharged to the lower vadose zone for over 20 years. Migration of these wastes from the lower vadose zone by the mechanisms of diffusion, leaching, and particulate transport is discussed. It is concluded that little movement of sorbed radionuclides by the above mechanisms within ten half-lives of even the long-lived radionuclides occurs; the sorbed radionuclides can only be removed from this zone by a cataclysmic occurrence in which the sediment in the zone and the entrained wastes are both physically removed. Field studies show that essentially all of the long-lived radionuclides disposed to the ground have been sorbed and remain in the upper levels of the lower vadose zone. Radionuclides which normally need to be considered in waste disposal include ^{90}Sr, ^{137}Cs, Pu, ^{60}Co, ^{106}Ru transition metals, rare earths, and ^{3}H. In many wastes ^{90}Sr is the radionuclide which limits ground disposal to Hanford sediments due to its long radioactive and biological half-lives and resulting low MPC. In sediments containing small amounts of mica, ^{137}Cs could become the limiting nuclide; however, ^{137}Cs has a much shorter biological half-life than ^{90}Sr, and therefore, a higher MPC. Much of the sediment of the Hanford project has a moderate mica content and exhibits high ^{137}Cs sorption. Due to the likelihood of ^{90}Sr and ^{137}Cs limiting the disposal of most wastes, a more detailed review of the sorption of these nuclides is included. (179 references.) (CH)

2560 (BNWL–1730) FRACTIONAL AIRBORNE RELEASE OF URANIUM (REPRESENTING PLUTONIUM) DURING THE BURNING OF CONTAMINATED WASTES. Mishima, J.; Schwendiman, L. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr 1973. Contract AT(45-1)-1830. 20p. Dep. NTIS $3.00.

Plutonium is a highly radiotoxic substance, but one of increasing importance as a source of fission energy. Detailed preplanning and evaluation are essential to insure safety in handling this element and its compounds. A source term containing both a fractional release and aerodynamic size distribution of the released material is required to evaluate the potential downwind hazard from a postulated inadvertent release. The approach taken in this study of a potential accident situation in a radiochemical processing plant was to measure the fractional airborne release and aerodynamic size distribution released using a simple but realistic simulation. The release of uranium (as a stand-in for plutonium) was measured during the burning of flammable, solid materials containing either uranium dioxide powder or uranium nitrate solution. The flammable materials used are representative of the typical types of solid wastes generated in such a process and were packaged in a typical manner. The packaged waste containing the uranium was allowed to burn in a 9^{5} ft diameter by 10 ft tall tank to simulate a small enclosure. The uranium airborne, deposited on the walls and floor, and remaining with the residues

was measured. The fractional airborne release of uranium measured under these conditions was 0.05 to 0.003% of the uranium used in the source. (auth)

2561 (BNWL-1734) AQUATIC BIOENVIRONMENTAL STUDIES IN THE COLUMBIA RIVER AT HANFORD, 1945-1971. A Bibliography with Abstracts. Becker, C. D. (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1973. Contract AT (45-1)-1830. 155p. Dep. NTIS $7.60.

Publications prepared by Hanford staff scientists that deal with bioenvironmental studies in the central Columbia River during the period 1945 to 1971 are listed and abstracted. Four general topics are covered: (1) biology and ecology of river organisms, (2) thermal and chemical effects of reactor effluent discharges, (3) radioactivity releases from reactor operations, and (4) hydrology of the Columbia River. Over 400 publications are included. The abstracts provide an insight into the scope and depth of diverse studies supported by the United States Atomic Energy Commission in order to evaluate any impact on the aquatic ecosystem (and to provide related data) throughout the "plutonium production phase" of the Hanford operations. (auth)

2562 (LA-5234-MS) REGIONAL SURVEY OF TRITIUM IN SURFACE AND GROUND WATER IN THE LOS ALAMOS AREA, NEW MEXICO, AUGUST 1966-MAY 1969. Purtymun, W. D. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. 9p. Dep. NTIS $3.00.

Surface and ground water samples were analyzed for tritium from 113 sampling stations during the period August 1966 through May 1969. Tritium was detected only in surface and ground water in the stream-connected aquifers in the alluvium of DP, Los Alamos, and Mortandad Canyons, which are controlled areas. These canyons receive treated low-level radioactive effluents. The tritium in DP and Los Alamos Canyon is from old seepage pits that contained tritium. The tritium concentrations decrease downgradient in the canyons due to dilution with other waste water, sewage effluent, and storm runoff. Tritium in the alluvium in Lower Mortandad Canyon is residual from a release into the canyon prior to August 1966. The concentrations decreased with time due to dilution by effluents and storm runoff. The surface and ground water in the alluvium is not a source of municipal or industrial water supply. (auth)

2563 (CONF-721030-) PROCEEDINGS OF AEC POLLUTION CONTROL CONFERENCE, OAK RIDGE, TENNESSEE, OCTOBER 25-27, 1972. (Division of Operational Safety (AEC), Washington, D. C.). Feb 1973. 557p. Dep. NTIS $6.00.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

Separate abstracts were prepared for 29 of the 35 papers included. Abstracts of six papers appeared in NSA previously as numbers 27: 214, 2443, 2520, 17948, 17949, and 22035. (CH)

For abstracts of individual papers see: 2447, 2448, 2564-2567, 2580, 2629-2641, 2647, 4960-4962, and 4965-4969.

2564 (CONF-721030-, pp 393-402) REDUCTION OF TRITIUM IN EXHAUST STACK EFFLUENTS AT PINELLAS PLANT. Holliday, J. N. (General Electric Co., St. Petersburg, FL). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

Reduction of tritium in exhaust stack effluent at the Pinellas Plant is attributed to a procedure change and the operation of a hydrogen oxidizing-collection system. The oxidizing-collection system in use at Pinellas is described. It is suggested that such a system, properly designed, could effect similar reductions at other locations. (auth)

2565 (CONF-721030-, pp 403-407) TRITIUM CLEANUP TECHNOLOGY AND SYSTEMS AT SANDIA LABORATORIES, LIVERMORE. Lovell, P. K.; Gildea, P. D. (Sandia Labs., Livermore, CA). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

With increased emphasis on environmental contamination control, dilution is no longer the acceptable solution. Tritium cleanup technology and systems designed for a new facility are described. Experiments and operations that might release significant activity will be conducted inside sealed enclosures. Two types of enclosures or glove boxes will be used. The majority of these glove boxes will be air atmosphere units. One inert atmosphere glove box will be required. This box differs from the air atmosphere boxes only in that inert atmosphere will be used. This unit will have an integral control system for maintaining an inert atmosphere. The air and inert atmosphere glove boxes will be connected to a gas purification system to remove tritium and tritiated water vapor from the gases contained in the hermetically sealed glove boxes, before the glove box gases are exhausted into the exhaust stack. Since the system's primary function is to remove tritium from the glove boxes, it must be leak tight, highly reliable, and provide for redundant components so that major processing system failures are avoided. (CH)

2566 (CONF-721030-, pp 408-453) TRITIUM EFFLUENT CONTROL PROGRAM AT MOUND LABORATORY. Kershner, C. J.; Rhinehammer, T. B. (Mound Lab., Miamisburg, OH). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

By coupling improved operating and administrative procedures with modifications to existing facilities, the gaseous tritium effluent at Mound Laboratory has been reduced by a factor of approximately six since 1969. Further facility modifications are planned which are expected to result in another factor of three reduction by 1975. In addition, a development program has been initiated to develop the monitoring and control capabilities for maintaining tritium effluent levels, as measured at the point of emission from the stacks, at or below 10% of present RCG limits. (auth)

2567 (CONF-721030-, pp 454-464) TRITIUM EFFLUENT REDUCTION PROGRAMS AT THE SAVANNAH RIVER PLANT. Jacobsen, W. R. (Savannah River Lab., Aiken, SC). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

Most tritium releases at the Savannah River Plant (SRP) result from two separate modes of tritium formation: neutron activation of the heavy water (deuterium oxide) used to moderate and cool the production reactors, and irradiation of lithium in the reactors to produce tritium. In addition, a lesser amount of tritium is formed as a result of uranium fission. In 1971, 63% of the SRP tritium releases resulted from processing the irradiated lithium and uranium and 37% from various sources associated with the reactor moderator. Also in 1971, 94% of the tritium was released to the atmosphere and 6% to aqueous effluent streams. Efforts to minimize tritium release from the reactors consist of an intensive leak reduction program and provisions for recovery of the D_2O carried on discharged reactor fuel. These efforts have been particularly successful in recent years in reducing the D_2O loss rate; however, the continued buildup of tritium concentration in the moderator has caused a lesser reduction in tritium releases. Preliminary estimates of the cost of removing tritium from the moderator or periodically supplying fresh D_2O indicate that these would be prohibitively expensive. The facilities for processing irradiated lithium utilize extensive systems for leak detection and recovery. Improvements to these systems and their utilization are under way or being studied, and it is concluded that as much as ~25% reduction in tritium released from the overall processing areas may be obtained at a reasonable cost. (auth)

2568 ECOLOGICAL HAZARDS FROM NUCLEAR POWER PLANTS. Abrahamson, D. E. (Univ. of Minnesota, Mineapolis). pp 795-811 of Careless Technology: Ecology and International Development. Farvar, M. T. Garden City, NY; Natural History Press (1972).

From the careless technology ecology and international development conference; Warrenton, Virginia, USA (8 Dec 1968). See CONF-681233-.

Environmental risks associated with the nuclear power industry are discussed. Over two-thirds of the total heat generated by a nuclear power station is discharged as waste into the local environment. Should this heat be introduced into lakes, rivers, or estuaries, serious and widespread changes can be expected. Vast quantities of radioactive wastes are formed in nuclear reactors and a portion of these wastes are presently being discharged into the local environment of the reactor. Should this practice continue as the nuclear industry expands, it will create a serious health and environmental hazard. The sources, quantities, and possible effects of the wastes, both thermal and radioactive, are outlined. Radioactive wastes are formed in highly concentrated form. Because they are so concentrated, they could be contained and, unlike fossil fuel wastes, need not be released into the environment. As with other wastes, it costs more to contain them than to dump them into the nearest waters or into the atmosphere. (auth)

2569 IMPACT OF THE GREAT LAKES ON THE AIR QUALITY OF URBAN SHORELINE AREAS: SOME PRACTICAL APPLICATIONS WITH REGARD TO AIR POLLUTION CONTROL

POLICY AND ENVIRONMENTAL DECISION MAKING. Cole, H. S.; Lyons, W. A. (Univ. of Wisconsin, Kenosha). pp 436-463 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

Recent studies indicate that the air pollution problems of the urban Great Lakes shorelines are magnified by the mesoscale effect of the lakes on dispersion. Deleterious lake effects are most pronounced during the warm season when stabilized lake air penetrates inland. Onshore flow associated with lake breeze and easterly gradient winds occurs on about 60% of warm season days in the Chicago-Milwaukee area. Several mesoscale regimes promote adverse dispersion phenomena including mixing depth reduction, plume trapping, continuous fumigation and/or recycling of pollutants. During stable onshore flow, lowest mixing depths occur nearest the shoreline where emissions and people are numerous. Heavy concentration of automobile traffic near the lake may result in pollutant build-up and photochemical smog during stable onshore flow with bright sunshine. Under the same conditions lake-induced fumigation causes excessive pollutant concentration inland from coal-fired shoreline power plants. Trapping of low level plumes is most serious at night or with overcast skies. The study finds that air pollution control agencies need to incorporate these adverse phenomena in the design of dispersion models and in formulating regulations. Evidence supports the need for reduction of automobile traffic near shorelines. Lake airports and lake freeways will adversely affect shoreline air quality. (auth)

2570 ELECTRICAL ENERGY OF THERMAL ORIGIN AND THE ENVIRONMENT. Pt. 2. Thermal Nuclear Power Plants. Edouard, L. (Electricite de France, Saint-Denis). Tech. Mod.; 64: No. 10, 31-32(Oct 1972). (In French).

The pollution likely to be released from nuclear reactors into the atmosphere if sufficient contamination precautions are not taken is considered. This pollution can be in the form of gaseous effluents: air for all types of reactors, CO_2 in the case of graphite-gas reactors, and N_2 and H_2 in the case of pressurized water reactors. The release of radioactivity into the different gaseous effluents was studied. The way in which the release of such contaminated products into the atmosphere can be avoided, eg monitoring and filtration of the air, is discussed together with the means adopted for monitoring the radioactivity at different nuclear plant sites. The biological monitoring techniques are also discussed. (France)

Radioactivity Monitoring and Transport

2571 (EUR-4944) ENVIRONMENTAL RADIOACTIVITY: ISPRA, 1971. de Bortoli, M.; Gaglione, P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 48p. Dep. NTIS (U. S. Sales Only) $4.50. EUR B.Fr. 60.-.

Results are reported from measurements carried out directly on the effluents as well as in the environment in order to assess the contribution by the Establishment to the population dose and the pre-existing radiation and contamination levels of natural origin and those due to world-wide fallout. The results of the determinations carried out in the field of non radioactive pollution are also reported for dusts and sulfur oxides. (auth)

2572 (LA-5184) ENVIRONMENTAL MONITORING IN THE VICINITY OF THE LOS ALAMOS SCIENTIFIC LABORATORY. Calendar year 1972. Herceg, J. E. (comp.) (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 54p. Dep. NTIS $3.00.

The environmental monitoring program in effect at the Los Alamos Scientific Laboratory of the University of California for calendar year 1972 is described. Results are given of routine monitoring of radiation levels and levels of radioactive and nonradioactive contaminants in the Laboratory environs, including the atmosphere, the Los Alamos water supply, local surface and ground water, sediments, and soils. Concentrations and levels are compared with applicable guide values and with results obtained at other geographical locations and locally during other reporting periods. Descriptions are given of special programs aimed at describing the physical and biological processes involved in the transport of laboratory-generated radionuclides in liquid waste disposal areas. There is also a description of an environmental survey of certain AEC-controlled land parcels, as well as geologic, seismic, and meteorological studies of the Los Alamos area. Technical notes discuss the use of the honeybee as a biological indicator of radiocontamination, a new gamma-ray pulse height analyzer system intended for field use, an automated meteorological data acquisition system, and the determination of salt in pine trees near Los Alamos roadways. (auth)

2573 (USGS-474-169) RADIOCHEMICAL MONITORING OF WATER AFTER THE CANNIKIN EVENT, AMCHITKA ISLAND, ALASKA, OCTOBER 1972. Amchitka-40. Schroder, L. J.; Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). May 1973. Contract AT(29-2)-474. 19p. Dep. NTIS $4.00.

The U. S. Geological Survey collected water samples from Amchitka Island, Alaska, during October 1972. Tritium determinations were made on all samples collected and gross alpha and gross beta/gamma determinations were made on 41 samples. The gross alpha and gross beta determinations when compared with previously determined ranges for fresh waters on Amchitka Island show no trends. (auth)

2574 APPLICATION OF ISOTOPE TECHNIQUES FOR STUDIES ON MECHANISMS OF LAND CONTAMINATION AND WATER POLLUTION. Ohmomo, Y.; Suzuki, H.; Saiki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 499-503(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

How radiation and radioisotopes are utilized currently to investigate the contamination mechanism on land and in water is explained by four examples: (1) Activable tracer used in the flow measurement of a river. Determination of the flow rate in a river is useful in connection with the investigation of its pollution and countermeasures. Br, Eu, and Dy, were used to determine downstream concentration for this purpose. (2) Fallout nuclides ^{90}Sr, ^{137}Cs, ^{144}Ce, and ^{106}Ru were used as tracers for studying the transfer from ground surface to water system. The quantities of the respective nuclides in ground surface, river, river sediment, and town water were surveyed in connection with the future land disposal of radioactive wastes. (3) Radioiodine was used in the survey of ground and water pollution. The transfer of ^{131}I in the gaseous form to land, plants, and fish is important, for example, in connection with the ^{131}I pollution of milk. (4) The intake and excretion of methylmercury, etc., labeled with ^{203}Hg in fish was measured. After oral intake, the transfer to the meat of the fish is examined in connection with "Minamata" disease. (Japan)

2575 EFFECTS OF A ROUTINE RADIOACTIVE RELEASE ON AQUATIC RADIONUCLIDE CONCENTRATIONS. Nelson, D. M.; Romberg, G. P.; Prepejchal, W.; Spigarelli, S. A. (Argonne National Lab., Ill.). pp 260-269 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

Samples of water, periphyton, crayfish and fish were collected near the Big Rock Point Nuclear Plant before, during and after a scheduled radioactive release. Prerelease 1971 samples contained lower radionuclide concentrations than were observed in 1970 samples. During the release, concentrations of ^{137}Cs and ^{134}Cs (primarily cationic) in discharge water agreed with calculated dilution levels, while levels of ^{65}Zn and ^{60}Co (primarily particulate) were lower than calculated levels. A time series of periphyton samples had a rapid uptake of ^{137}Cs and ^{134}Cs corresponding to exchange rates with the water of 0.13 and 0.15 1 hr/g dry wt, respectively. Uptake data for ^{65}Zn and ^{60}Co in periphyton were erratic and were not amenable to calculation of exchange rates. Crayfish collected from the discharge channel five hours after the release had radionuclide concentrations 3 to 10 times higher than prerelease samples. The levels attained in periphyton and crayfish after the release were similar to levels observed in 1970. Concentrations of ^{137}Cs, ^{65}Zn and ^{60}Co in fish collected from the discharge channel were variable, but showed no apparent increase the day following the release. Radionuclide concentrations in fish were lower at Big Rock in 1971 than were observed in 1970, but higher than in similar fish collected at other locations in Lake Michigan. (auth)

2576 ENVIRONUCLEONICS, AN ALTERNATE NAME FOR HEALTH PHYSICS. Berk, H. W. (Univ. of Virginia, Charlottesville). Health Phys.; 24: No. 5, 588(May 1973).

It has been decided to call a new course which is being offered at the University of Virginia, Environucleonics and this will cover: the application of the principles of radiation physics to environmental and radiological health science problems; the interaction of radiation with biological systems; determination of absorbed dose and exposure; and protection limits and the movement of radioactive material in the environment. It is suggested that, in order to achieve some degree of uniformity in the titles or names of formal courses covering radiation protection, the name Environucleonics be considered. (UK)

2577 ENVIRONMENTAL HEALTH ASPECT IN THE NUCLEAR ENERGY INDUSTRY. Genshi Doryoku Kenkyukai Teirei

Kenkyukai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

The development of nuclear energy in the direction of geoecology is reexamined. In this study reports by Gofman and Tamplin, and Sternglass, and papers of the symposium on environmental problems by International Atomic Energy Association and the United States of America Atomic Energy Commission (IAEA/USAEC) were examined. Gofman and Tamplin recommended at the subcommittee on air and water pollutions in U. S. Upper House in November 1969, that maximum permissible dose of whole groups in the peaceful use of atomic energy must be reduced from 170 mrem/year to 17 mrem/year. They insisted that the maximum permissible dose must be based upon the doubling dose which doubles rate of the spontaneous genesis of cancer. E. J. Sternglass proposed that present dose standard should be reexamined because of fairly good correlation between infant mortality in Illinois and released radiation from the nuclear plant Dresden I. At the symposium of IAEA/USAEC on the environmental problems regarding power reactors, models of electric power demand and of economic structure were considered to estimate future electric power demand, and problem of the permissible dose was reexamined by mortality. With regard to the problem of effluent, air pollution by power plants using fossil fuel and that by the plants using nuclear fuel were compared, and released amount of radioactive materials from boiling water reactors, problem of high temperature drainage and other problems were investigated. (JA)

2578 AIRBORNE RADIOIODINE SAMPLING IN THE FIELD OF RADIATION MONITORING. Naritomi, M. (Japan Atomic Energy Research Inst., Tokai); Fukuda, S. Kuki Seijo; 10: No. 2, 79-94(Jun 1972). (In Japanese).

Several types of samplers for airborne radioiodine have been developed. Particles of the iodine are collected with filter-paper as dust. Gaseous iodine is collected by chemical reaction or adsorption. Charcoal seems to be a highly useful material for the collection of the radioiodine. The airborne iodine is found in two chemical forms, i.e., inorganic and organic compounds. The former is easily removed from the air, but removal of the latter is more difficult. Composition of the airborne iodine depends largely on the type and ability of ventilation-filtration system. The samplers for radioiodine are usually composed of charcoal filters and cartridges, and radioactivity of the collected iodine is monitored. Many kinds of the charcoal filters and cartridges have been produced. In most cases, efficiency is insufficient in the removal of organic iodine. Humidity affects unfavorably on the efficiency. Some effort has been made to improve ability of the samplers at high humidity. It was found that charcoal impregnated with TEDA or SnI_2 has high ability at high humidity, but the ability decreases in the presence of other off-gases. If the organic iodine is decomposed by electric discharge or heating, the removal with charcoal comes to be easier. If flowing air is heated up to 100°C, not only relative humidity decreases but also CH_3I is held tightly on the charcoal, by activation adsorption. This method is most excellent in the accurate evaluation of radioiodine concentration in the air. (JA)

Atmosphere

Refer also to abstracts 2450, 2609, 2611, 2647, 2908, and 4960–4962.

2579 (CEA-R-4128(2)) DISTRIBUTION OF RADIOACTIVITY IN THE ENVIRONMENT OF A CONTAINED NUCLEAR EXPLOSION. 2. Theoretical Study: Behavior of the Microconstituents of the Environment and the Nuclear Explosive Between 3000 and 6000°K at Pressures Between 1 and 500 Bars. Balard, F.; Covhines, J.; Lutz, M. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). May 1973. 40p. (In French). Dep. NTIS (U. S. Sales Only) $4.00.

The development of a computer program intended to solve a set of chemical equilibria in the gaseous phase is described. With an IBM 360/40 disk operating system computer, one can compute a system of chemical equilibria including up to one hundred and two constituents in varying proportions from 10^{-10} per cent to 100 per cent. The application of the program to the chemical study of tritium, plutonium, uranium, and long-life fission products is described. The computation is made under conditions close to those (1 to 500 bar; 3000 to 6000°K) of the cooling cavity of a contained nuclear explosion in granitic medium. (auth)

2580 (CONF-721030-, pp 29-42) SIGNIFICANCE OF FEDERAL AND STATE AIR POLLUTION STANDARDS. Schulte, H. F. (Los Alamos Scientific Lab., NM). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

The history of the development of air pollution standards in the USA is reviewed. The impact of the Federal Clean Air Act and its subsequent amendments on the development of State air pollution standards in compliance with Federal standards is discussed. The Environmental Protection Agency (EPA) promulgated national ambient air quality standards for a variety of substances including total particulates, sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, and photochemical oxidants. Some States adopted ambient air quality standards that also included hydrogen sulfide, total reduced sulfur, lead, beryllium, arsenic, copper, and zinc. No ambient air standards for radioactive materials have been promulgated by the EPA, but standards have been developed by the AEC, the NCRP, and the ICRP. These are largely based on the application of reduction factors to the occupational exposure standards. While ambient air quality standards define maximum concentrations in the atmosphere to which the general population may be exposed, emission standards define the rate of emission or amount of material that may be emitted from an installation without causing ambient standards to be exceeded. Emission standards are usually expressed in terms of mass of material emitted per unit time, and are usually specific for a given plant or type of plant. Emission standards may vary from one community to another depending on meteorological factors and the number of sources in the community. The EPA has established emission standards for automobiles, fossil-fueled steam generators, incinerators, cement plants, nitric acid plants, and sulfuric acid plants and has proposed standards for asbestos, beryllium, and mercury. The American National Standards Institute (ANSI) has also developed standards for occupational exposure and the National Institute of Occupational Safety and Health (NIOSH) are preparing criteria documents which include recommendations for occupational standards. (CH)

2581 (ORO-2529-36) ATMOSPHERIC RADIOCHEMISTRY. Annual Progress Report. Kuroda, P. K. (Arkansas Univ., Fayetteville. Dept. of Chemistry). 30 Apr 1973. Contract At(40-1)-2529. 181p. Dep. NTIS $11.25.

Samples of rain and snow collected at Fayetteville, Arkansas (36°3′ N, 94°10′ W) were analyzed by γ spectroscopic methods to determine the ratios of $^{141}Ce/^{144}Ce$, $^{89}Sr/^{90}Sr$, and $^{140}Ba/^{90}Sr$ in fallout from recent Chinese and French nuclear weapons tests. Three Chinese thermonuclear weapons tests were the major sources of nuclear debris in the Northern Hemisphere from late 1968 through mid-1970. The $^{89}Sr/^{90}Sr$ ratios in atmospheric samples increased slowly for several months following each nuclear test. Precipitation scavenging did not have a well-defined relationship with time, amount of rainfall, or a number of meteorological parameters. Variations in the number and size of individual fallout particles were measured following the Chinese tests of January 7 and March 18, 1972. The activities of the radon daughters ^{210}Bi, ^{210}Pb, and ^{210}Po were measured in a large number of samples of rain and snow and it was concluded that the residence times of $^{210}Bi/^{210}Pb$ and $^{210}Po/^{210}Pb$ can be used as tracers of air movement and the mixing of surface and tropospheric aerosols. (CH)

2582 (SCPRI(RM)-1-1973) REPORT OF ACTIVITY, JANUARY 1973. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1973. 18p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Data are presented from environmental radiation monitoring activities in France during January 1973. Data on fallout activity at a network of 30 sampling stations and activity in atmospheric and water samples collected in the environs of nuclear installations are included. (CH)

2583 (SCPRI(RM)-1-1973(Supp.)) ANNEX TO MONTHLY REPORT, JANUARY 1973. Detail of Results of Measurement. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1973. 27p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

Detailed results of radiation monitoring of environmental samples collected throughout France during January 1972 are presented. Fallout was sampled at 30 stations and samples of atmosphere and water were collected in the environs of nuclear installations. (CH)

2584 (TLW-6105) ANALYSIS OF ^{239}Pu PARTICLES COLLECTED NEAR THE ROCKY FLATS FACILITY. Final Report. Nathans, M. W.; Holland, W. D. (Trapelo/West Richmond, Calif.). 25 Oct 1971. Contract NY-72-1915. 29p. Dep. NTIS $3.50.

Results of the analysis of some air filter samples conducted to determine the relation between the size and the plutonium content of particles of airborne material collected at the periphery of the Rocky Flats plant are reported. Some conclusions derived from

the measurements of a limited number of air filter samples are: the plutonium content of particles in the air samples is a small fraction of their total content; plutonium-containing particles have a size distribution which is much larger than that for all particles on the air filters; and the size distribution of all particles on the air filters is about the same as that for the soil samples, except that very large particles are not present in the air samples. (DHM)

2585 EXTINCT LUNAR RADIOACTIVITIES: XENON FROM ^{244}Pu AND ^{129}I IN APOLLO 14 BRECCIAS. Behrmann, C. J.; Drozd, R. J.; Hohenberg, C. M. (Washington Univ., St. Louis). Earth Planet. Sci. Lett.; 17: No. 2, 446-455(Jan 1973).

Two Apollo 14 breccias have been found to contain xenon from the spontaneous fission of 82 My ^{244}Pu. A third contains 60 times as much fission xenon as local uranium can account for and is probably of similar character. One of the breccias shows a ^{129}Xe excess most likely due to the decay of 17 My ^{129}I. That these components can be separated and identified at all implies that complete isotopic homogenization has not occurred over a period which encompasses both extinction of these radionuclides and compaction of the breccias into their final form. In this sense isotope prehistory has been preserved in some lunar breccias providing information that pre-dates the formation of the rock itself (as determined by conventional techniques). The gases are not due to in situ decay. They appear to have been implanted in the surface crustal layer of the primitive Moon nearly simultaneously with production by ^{244}Pu and ^{129}I decay in the lunar interior. The combination of these two radionuclides, whose relative abundance is strongly time dependent, forms the basis of a new, extremely sensitive, dating scheme that establishes the time of implantation. (auth)

2586 γ-RAY SPECTRA AND FRACTIONATION EFFECT OF THE HIGHLY RADIOACTIVE FALLOUT DUE TO THE NUCLEAR TEST EXPLOSION. Tatewaki, T. (Shinshu Univ., Nagano, Japan). Shinshu Daigaku Kogakubu Kiyo; No. 31, 23-32(Dec 1971). (In Japanese).

The γ spectra from the highly radioactive fallout particles due to the nuclear test explosion in China on 24 Dec. 1967 were measured by a Ge(Li) detector with high resolution. Many nuclides were identified in the γ-ray spectra without any chemical processing. The nuclides of the fission products such as ^{95}Zr, ^{95}Nb, ^{99}Mo—^{99m}Tc, ^{131}I, ^{133}I, ^{133}Xe, ^{140}La, ^{141}Ce, ^{144}Ce, and ^{147}Nd were identified. Among the induced radioactive nuclides produced from ^{238}U, ^{239}Np was also identified, but ^{237}U was not found. The fractionation factors of the nuclides $^{140}Ba + ^{140}La$, ^{141}Ce, ^{144}Ce, and ^{147}Nd in the highly radioactive fallout particles were calculated respectively. It was found that the values of the relative activity ratio of ^{239}Np to $^{95}Zr + ^{95}Nb$ of a single particle were very different. (auth)

2587 RADIOACTIVE CERIUM ISOTOPES. The Fallout from Recent French and Chinese Nuclear Weapons Tests. Sherwood, J. D.; Moore, D. T.; Kuroda, P. A. (Univ. of Arkansas, Fayetteville). Health Phys.; 24: No. 5, 491-495(May 1973).

A new method involving gamma-ray spectroscopy was employed to determine the $^{141}Ce/^{144}Ce$ ratios in individual samples of rain and snow collected at Fayetteville, Arkansas (36°3′N, 94°10′W). By the use of a Ge(Li) detector, the counting period for the cerium samples can now be shortened from over 8 months to only 1 day. The presence was noted of fresh nuclear debris in the Northern tropospheric rain from the French nuclear weapons tests conducted in the Southern Hemisphere during the summer months of 1970, followed by the appearance of fresh Chinese debris after October 1970. (auth)

Soil

2588 CONTRIBUTION OF ADSORBED IONS TO THE DIFFUSION OF ^{90}Sr IN SOILS. Prokhorov, B. M.; Frid, A. S. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 536-542(1972).

Translated from Radiokhimiya; 14: No. 4, 519-526(1972).

It was shown that the change in the actual rate of diffusion of ^{90}Sr in soil is caused by a change not only in the value of the adsorption, but also in the rate of diffusion of ions both in the pore solution and in the adsorbed state. The contribution of adsorbed ions to the total diffusion transport of ^{90}Sr in unsalted soil exceeds the contribution of ions of the soil solution and in many cases is more than 90%. The rate of diffusion of ^{90}Sr in the adsorbed state is 0.2 to 3.3% of the corresponding values for the pore solution. The contribution of adsorbed ions of ^{90}Sr decreases with increasing concentration of the soil solution, while at higher concentrations (0.5 N and higher) it again increases. The diffusion coefficient of adsorbed ^{90}Sr ions increases with increasing concentration of the soil solution, reaching values corresponding to the diffusion of Sr^{2+} in solution at very high concentrations. (auth)

2589 DISTRIBUTION OF ^{137}Cs IN SOILS AND VEGETATION ON THE ISLAND OF PUERTO RICO. Kline, J. R.; Colon, J. A.; Brar, S. S. (Argonne National Lab., IL). Health Phys.; 24: No. 5, 469-475(May 1973).

Soils and vegetation of Puerto Rico were collected along five north-south transects of the island and analyzed for ^{137}Cs content. The results showed an apparent gradient of this nuclide with high amounts in the eastern samples and low amounts in the western samples. Activity in samples was strongly related to rainfall patterns on the island; however, high mountain forests were much more highly contaminated than could be accounted for on the basis of rainfall deposition alone. This was attributed to the properties of vegetation itself, rather than alteration of deposition patterns. The vegetation is suggested to have high aerosol interception efficiency and low turnover rates, which could combine to produce the observed concentrations. The data were used to test and reject the hypothesis that observed ^{137}Cs distribution on the island was due to changes in atmospheric aerosol scavenging efficiency. Data from soil samples suggest that the island has intercepted a minimum of 535 Ci of ^{137}Cs from past nuclear weapons tests. (auth)

2590 COMPLEXING OF THE ORGANIC MATTER OF A SEDIMENT AND CERTAIN RADIOISOTOPES. Distribution of these Radioisotopes as a Function of the Molecular Weight of the Organic Substances. Faure, J. (Centre Univ., Perpignan, France); Viallet, P.; Grauby, A.; Picat, P. Compt. Rend. Hebd. Seances Acad. Agr. Fr.; 58: No. 6, 377-383(1972). (In French).

Two fractionating methods (gel chromatography and ultrafiltration) were used to study the organic matter of a sediment taken from the Rhone and contaminated with radioisotopes. Spectroscopic and nuclear techniques demonstrated that the organic matter obtained (under given extraction conditions) consisted principally of molecules having molecular weights of less than 500 to 700 with which most of the radioactivity is associated. (auth)

2591 MOVEMENT OF RADIONUCLIDES THROUGH SATURATED SAND ZONES. Tsutsui, T.; Nishimaki, K. (Kyoto Univ., Osaka). Doboku Gakkai Ronbun Hokokushu; No. 200, 25-29(Apr 1972). (In Japanese).

The modes of movement of radioactive nuclides through water-bearing formations, when they escape from the radioactive wastes stored underground and mix into groundwater were studied. The nuclides used in this study are ^{90}Sr, ^{60}Co, and ^{137}Cs, and the aquifer used is sand. The study was done for the following three cases, in which they move (1) through the ordinary aquifer, (2) through the aquifer affected by some nitric acid wastes, and (3) mixing with nitric acid wastes, such as reprocessing waste-solution. It was known from this study that the movement of these nuclides is relatively slow, and that their speed is some 30% higher in the aquifer previously affected by the nitric acid waste-solution than in the ordinary aquifer. (Japan)

Water

2592 ^{210}Pb–^{226}Ra: RADIOACTIVE DISEQUILIBRIUM IN THE DEEP SEA. Craig, H.; Krishnaswami, S.; Somayajulu, B. L. K. (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 17: No. 2, 295-305(Jan 1973).

^{210}Pb and ^{226}Ra profiles have been measured in the North Atlantic and North Pacific Deep Water. The ^{210}Pb activity is 25% to 80% of that of ^{226}Ra, averages about 50% in each profile, and is lowest in the bottom water. This deficiency of ^{210}Pb relative to ^{226}Ra shows that ^{210}Pb is rapidly and continually scavenged from deep water, probably by adsorption on particulate material sinking from the surface. A method is developed for simultaneous application of the vertical diffusion-advection model to ^{226}Ra and ^{210}Pb deep-water profiles, and the in-situ source terms for both isotopes are obtained as a function of the parametric upwelling velocity. For a positive source term for ^{226}Ra in deep water, the parametric velocity is limited to a small range (3 – 12 My) and the deep-Pacific residence time of lead is 54 y, a value two orders of magnitude smaller than residence times estimated from stable lead concentrations. The model calculations show that an in-situ scavenging process, acting throughout the water column, is required to remove the Pb. Box model calculations yield a similar short residence time for lead in North Atlantic Deep Water, indicating that radioactive disequilibrium for ^{210}Pb, due to fast scavenging, is a general phenomenon through the deep sea. (auth)

2593 ^{226}Ra IN THE EASTERN EQUATORIAL PACIFIC. Chung, Y. C.; Craig, H. (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 17: No. 2, 306-318(Jan 1973).

^{226}Ra profiles have been measured at four stations in the vicinity of the East Pacific Rise, one station in the NE Pacific, and one station in the NW Atlantic. We confirm the large increase in ^{226}Ra in North Pacific Deep Water vs North Atlantic Deep Water, measured by Broecker, Li, and Cromwell, but we find a factor of 3.3 vs their factor of 2. The vertical diffusion-advection model is applied to the Pacific deep water profiles to evaluate the magnitude of in-situ production of ^{226}Ra from dissolution of particulate flux — an effect which cannot be determined from box-models. The in-situ production rate J and the parametric upwelling velocity w are linearly correlated so that a range of J−w pairs is obtained, all of which yield essentially identical profiles for both positive and negative values of J. However, variance mapping in J−w space gives an upper limit for J, a lower limit for w, and a critical velocity for which J = 0. Thus if the constraint $J \geq 0$ is assumed, the Pacific profiles indicate maximum J values of 1.5×10^{-17} (g/kg)y, with upwelling velocities limited to values between 1 and 12 M/y. Three of the profiles can be fit with J = 0, w = 3−4 M/y, while two profiles require large upwelling velocities (12−14 M/y) for J = 0. We conclude that there may indeed be a small in-situ production of ^{226}Ra in the deep Pacific (replacement residence time >4000 y), but if so, it is probably confined to specific areas of the ocean. In contrast, two recently published Pacific barium profiles show no evidence of in-situ production in the water column. (auth)

2594 EXCESS RADON IN THE SANTA BARBARA BASIN. Chung, Y. C. (Univ. of California, San Diego, La Jolla). Earth Planet. Sci. Lett.; 17: No. 2, 319-323(Jan 1973).

Two excess-radon profiles were measured in the Santa Barbara basin in July and November, 1970. The November profile, with a maximum excess at 25 m above the bottom, is a transient profile probably produced by a turbidity current. The July profile, with excess radon decreasing exponentially upward, is treated as a stationary profile which gives a vertical eddy coefficient of 3.9 cm^2/sec, based on a simple steady-state diffusion model. (auth)

2595 RATIOS OF THE AVERAGE CONCENTRATIONS OF URANIUM AND ORGANIC MATTER IN RECENT SEA AND OCEAN SEDIMENTS. Baturin, G. N. Dokl. Akad. Nauk SSSR; 207: No. 1, 186-189(1 Nov 1972). (In Russian).

Values of the ratio $U/C_{org.}$ were obtained on recent sediments of the major seas and oceans of the Earth. Two classes were recognized: "background" U content ($<5 \times 10^{-4}$%) and higher ($>5 \times 10^{-4}$%). A relative uniformity of $U/C_{org.}$ among the samples tested indicated that on the whole the possibilities of accumulation of hydrogenic U in the organic components of the sediments were limited. (KSW)

Ecosystems and Food Cycles

2596 (CONF-720708-13) FLUX OF Mn, Fe, AND Zn IN AN ESTUARINE ECOSYSTEM. Wolfe, D. A.; Cross, F. A.; Jennings, C. D. (National Marine Fisheries Service, Beufort, N. C. (USA). Atlantic Estuarine Fisheries Center). 1972. 21p. (SM−158/10). Dep. NTIS $3.25.

From symposium on the interaction of radioactive contaminants with the constituents of the marine environment; Seattle, Washington, USA (10 Jul 1972).

Cycling of radionuclides in estuarine ecosystems involves a complex network of interactions among sediments, dissolved components, biota, and fluctuating environmental variables, e.g., temperature, salinity, and pH. Accurate prediction of the distribution of radionuclides in the various components requires a thorough understanding of the flux of stable elements through the system. We will describe our efforts to model the fluxes of Mn, Fe and Zn through and within coastal plain estuaries of southeastern United States. Data have been derived mainly from extensive study of the Newport River estuary, a North Carolina embayment of about 31 km^2 receiving runoff from a total watershed area of about 340 km^2. Trace metals have been analyzed on a seasonal basis in water, sediments, and dominant organisms from several locations in this ecosystem. Ecological studies have produced estimates of seasonal variability and biomass for the major primary producers, zooplankton, and the dominant species of macroinvertebrates (infauna and epibenthos) and fish. (auth)

2597 (RT/BIO-(72)77) STUDIES ON THE RADIOACTIVE CONTAMINATION OF THE SEA. Annual Report, 1971. Bernhard, M. (ed.) (Comitato Nazionale per l'Energia Nucleare, La Spezia (Italy). Laboratorio per lo Studio della Contaminazione Radioattiva del Mare). 1972. 161p. (EUR-4865). Dep. NTIS (U. S. Sales Only) $10.25.

Results are reported from studies of the factors which influence the uptake, accumulation, and loss of radioisotopes by different inorganic and organic constituents of the marine environment. Data are included on relevant radioecological and ecological factors in nature and under laboratory conditions, and an investigation of the outfall area of the Mediterranean Sea off-shore of the CNEN-TRISAIA Centre fuel reprocessing plant. (CH)

2598 DAILY INTAKE OF COBALT BY THE ADULT POPULATION OF TARAPUR. Bhat, I. S. (Tarapur Atomic Power Station, India). Health Phys.; 24: No. 5, 553-554(May 1973).

Dietary intakes of stable elements whose radioisotopes are likely to be released in the discharged effluents from atomic power stations are of considerable interest in a radiation surveillance program. Investigations of the dietary intake levels and the amount of cobalt contributed by different food components of daily diet (cereals, pulses, vegetables, sea food, milk and milk produce, meat) at Tarapur are reported and compared with those in Japan and USA. (UK)

2599 OCCURRENCE OF ^{75}Se AND ^{113}Sn IN OYSTERS. Patel, B.; Ganguly, A. K. (Bhabha Atomic Research Centre, Bombay). Health Phys.; 24: No. 5, 559-562(May 1973).

During the radioecological surveillance of Tarapur waters on the west coast of India which receive radioactive wastes from the operations of a 400 MWe BWR power station, oysters Crassostrea cucullata Born and Crassostrea gryphoides Schlotheim, which are harvested from an oyster farm in the vicinity were sampled. Selenium-75 and ^{113}Sn were found and their origin is considered. Other molluscs were found to concentrate specificially radionuclides of cobalt. Thus various species examined exhibit species-specificity when concentrating trace elements and their radionuclides under the natural environmental conditions. Considering the specific ability of oysters to concentrate Se and Sn and their radionuclides, oysters could be used as indicators of pollution due to radionuclides of tin and selenium. (UK)

2600 GENERAL RECOMMENDATION FOR DESIGNING MARINE RADIOECOLOGICAL EXPERIMENTS. Renfro, W. C.; Fowler, S. W. (International Atomic Energy Agency, Monaco Ville). Health Phys.; 24: No. 5, 572-573(May 1973).

It is often difficult or impossible to compare the results of field or laboratory radioecological experiments. Fundamental differences in experimental approaches and techniques used by different investigators can preclude any useful comparisons of their data or conclusions. Recognizing this problem, the IAEA sponsored a small seminar to discuss the comparability of various experimental methods for measuring the fluxes of radionuclides through marine organisms and ecosystems and the problems of extrapolating laboratory results to predict the fates of radionuclides in natural environments. Many of the problems encountered in designing radiotracer experiments were considered in detail. Six general recommendations evolved from these discussions. These recommendations are presented here in the hope that they will be considered by workers designing experiments concerning the movements and fates of radionuclides in the marine environment. (UK)

2601 FALLOUT ^{137}Cs LEVELS IN MAN OVER A 12 YR PERIOD. Shukla, K. K.; Dombrowski, C. S.; Cohn, S. H. (Brookhaven National Lab., Upton, NY). Health Phys.; 24: No. 5, 555-557(May 1973).

Body burdens of ^{137}Cs observed in a selected population of Long Island from the beginning of 1960 until the end of 1971 are presented. Estimates of total radiation dose are also given and the results are compared with those of other investigators. (UK)

2602 SIMPLE MODEL OF STRONTIUM AND MANGANESE DYNAMICS IN A TROPICAL RAIN FOREST. Jordan, C. F. (Argonne National Lab., IL); Kline, J. R.; Sasscer, D. S. Health Phys.; 24: No. 5, 477-489(May 1973).

Quantities and fluxes of stable strontium and manganese were measured in a Puerto Rican tropical rain forest. These measurements were used to formulate a mathematical model of the dynamics of these elements. The model was then used to make predictions of the fate of the radioactive analogs of these isotopes after input via atmospheric fallout. The model was partially validated by measuring actual fallout levels in the forest during part of the time span covered by the model's predictions. (auth)

Radiometric Techniques

Refer also to abstracts 2574, 2581, and 2805.

2603 $^{207}Pb/^{206}Pb$ AGES OF INDIVIDUAL MINERAL PHASES IN LUNA 20 MATERIAL BY ION MICROPROBE MASS ANALYSIS. Andersen, C. A.; Hinthorne, J. R. (Hasler Research Center,

Goleta, CA). Geochim. Cosmochim. Acta; 37: No. 4, 745-754 (Apr 1973).

Ion microprobe analyses of returned lunar material have helped to demonstrate that U, Th, and radiogenic Pb are concentrated in small accessory mineral phases. It is possible to measure the isotopic composition of this Pb and obtain a radiometric $^{207}Pb/^{206}Pb$ age for the mineral. The ages so derived compare favorably with crystallization ages determined by conventional methods. A grain mount (22003,2/6) of Luna 20 material was searched for such accessory mineral phases and two were found. One of these phases gives an age of 4.12 ± 0.04 b.y. and the other an age of 4.42 ± 0.11 b.y. Ages of minerals dated by the ion probe in Apollo samples 14310 and 15555 are given for comparison. Data on the upper limit for Pb concentration in the outermost surface layers of free lunar soil particles are also given. (auth)

2604 POSSIBILITY OF USING PULSED NEUTRON–NEUTRON LOGGING IN DETERMINATION OF WATER–OIL CONTACT WITHIN THE PROMISING STRATIGRAPHICAL SERIES AND REGIONS OF POLAND. Balowa, Z. (Petroleum Inst., Krakow). Przegl. Geol.; 19: 503-505(1971). (In Polish).

The possibilities of using impulse neutron logging in examination of the water-oil contact under Polish geological conditions are considered. These possibilities are presented in the light of a schematic review of sedimentary basins and geological regions of Poland, promising in search for crude oil. It has been ascertained that the best conditions for studying the water–oil contact, by means of impulse neutron generators are within the most reservoir rocks of Palaeozoic age. (auth)

2605 $^{228}Th/^{232}Th$ AND ^{210}Pb GEOCHRONOLOGIES IN MARINE AND LAKE SEDIMENTS. Koide, M.; Bruland, K. W.; Goldberg, E. D. (Scripps Institution of Oceanography, La Jolla, CA). Geochim. Cosmochim. Acta; 37: No. 5, 1171-1187(May 1973).

Two dating techniques, applicable to coastal marine and lacustrine sediments over periods ranging from years to a century, evolve from the natural radioactive series: Th-228/Th-232 from the Th-232 series and Pb-210 from the U-238 series. There is an excess of Th-228 over and above that supported by the parents Th-232 or Ra-228 in such deposits. The amounts of Th-232-supported and Ra-228-supported Th-228 are similar, indicating that both radium and thorium isotopes are removed from solution in these coastal zones quite rapidly after introduction or formation. The radium isotopes are probably transferred from the overlying waters to the sediments via phytoplankton, where they are reportedly enriched. In the surface levels of the deposits analyzed, there is nearly an order of magnitude more unsupported than supported Th-228. This excess Th-228 can be used both for dating purposes over time periods of the order of a decade and as permissive evidence that the uppermost levels of the deposit were obtained during the coring operation. Preliminary results from several lakes indicate the possibility that Th-228/Th-232 geochronologies are held by their sediments. Average rates of accumulation of lake sediments have been obtained from decreases in Pb-210 activity as a function of depth, although surface layers of the deposits may not have been recovered in the coring operation. Finally, Pb-210 geochronologies have been extended from varved to unvarved marine sediments. (auth)

2606 RADIOACTIVITATEA APLICATA IN INDUSTRIA PETROLIERA. (Radioactivity Applied in the Petroleum Industry). Peteu, G.; Sandru, P. Bucharest; Editura Academiei Republicii Socialiste Romania (1971). 208p.

This volume gives information on the logging techniques based on natural radioactivity of rocks, scattering of gamma radiations and neutrons, as well as information on the examination of the technical state of bore holes through the radioactive tracer technique. The book also includes chapters pertaining to the analysis by activation and x fluorescence, which treat problems specific for the petroleum industry, obviously with a larger realm of applications. By its manner of approaching the problems the volume is mainly intended for engineers, physicists and chemists working in the petroleum industry and to teaching staffs of higher education institutes. It may also be useful to specialists in fields with industrial application of radioactivity. (auth)

Site Surveys

Refer also to abstracts 2559, 2579, 3449, 4770, 4882, and 4930.

2607 (BMI-171-148) FRESHWATER VERTEBRATE AND INVERTEBRATE ECOLOGY OF AMCHITKA ISLAND. Amchitka Bioenvironmental Program. Annual Progress Report, July 1, 1971–June 30, 1972. Helm, William T.; Valdez, R. A. (Utah State Univ., Logan (USA). Coll. of Natural Resources). Apr 1973. Contract AT(26-1) 171. 17p. Dep. NTIS $3.00.

For Battelle Columbus Labs., Ohio.

Irreversible damages occurred in at least five study lakes, three with fish populations, and in one stream system on Amchitka as a result of Cannikin underground nuclear explosion. An estimated loss of 10,700 freshwater fishes, of which 7% were game fish, was distributed over eight ponds. The greatest effect of Cannikin-generated pressure changes to a fish population was an estimated 15 percent loss of three-spine stickleback in a pond 1,210 meters from SZ. In comparison, the loss of 85% of the stickleback in a pond 500 meters from SZ was reported for the Milrow event in 1969. A survey of Amchitka salmon streams in 1971 revealed markedly fewer returning adults than the previous year; this reduction is not believed to be related to the nuclear testing program since pink salmon spawning migrations are typically different in size between even and odd years in many streams. Only 100 adults were found in 4 of the 23 streams surveyed in 1971 as compared to the estimated 674 in 21 of these streams the previous year. Oil and silt are two pollutants found to be entering some lakes (<0.2% of total number on Island) and streams (<5% of total on Island) on Amchitka. Drilling mud, containing oil, has caused severe but probably short-term depletion of aquatic populations; silt may have longer lasting effects. (auth)

2608 (BMI–171-150) AMCHITKA BIOENVIRONMENTAL PROGRAM. Research Program on Marine Ecology, Amchitka Island, Alaska. Annual Progress Report, July 1, 1971–June 30, 1972. Nakatani, R. E.; Isakson, J. S.; Burgner, R. L. (Washington Univ., Seattle. Fisheries Research Inst.). Apr 1973. Contract AT(26-1)-171. 73p. Dep. NTIS $3.00.

For Battelle Columbus Labs., Ohio.

Research continued on the marine environment of Amchitka Island for evaluation of the short- and long-term effects of Cannikin (November 6, 1971), as well as some long-term effects of Milrow (October 2, 1969). The principal features studied included marine fish, invertebrates, and algae. Other marine sampling was conducted for the University of Washington Laboratory of Radiation Ecology and the U. S. Geological Survey. The most obvious effect of Cannikin was localized disruption of intertidal invertebrate and algal communities as a result of permanent uplift of the adjacent intertidal benches. Present information indicates that 6.1 km (alongshore distance) of Bering coastline had detectable algal damage attributable to Cannikin. Offshore studies revealed significant reduction in catches (November) of rock sole after Cannikin. Nearshore studies revealed marked declines in rock greenling catches immediately postevent followed by a stabilization of catches below preevent levels. About 300 dead fish, mostly rock greenling, were recovered postevent but the decrease in catches indicated that many more than this were killed by the Cannikin test. Further sampling offshore and nearshore is planned for determination of any long-term effects on the fish population. The impact of Cannikin on the entire Island's marine ecology is small because of the localized areas of intertidal bench, off-shore waters, and nearshore waters involved. Recovery of uplifted intertidal bench that is still in the intertidal zone is expected with floral and faunal succession. Recovery of fish populations in offshore and nearshore waters to pretest levels is expected by immigration because habitat disruption is localized and not great enough to reduce the carrying capacity of disrupted areas. Algal recolonization of Milrow-disturbed intertidal areas progresses with replacement of Hedophyllum by Fucus in part of the Duck Cove fault study area and colonization at the Duck Cove rockfall site leading to algal growth comparable to that on nearby undisturbed rocks. Siltation on the intertidal bench below the Square Bay rock slide is reduced in area, compared to 1971 observations. (auth)

2609 *(BNWL–1738)* *USE OF HANFORD WASTE PONDS* BY WATERFOWL AND OTHER BIRDS. Fitzner, R. E.; Price, K. R. (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1973. Contract AT(45-1)-1830. 47p. Dep. NTIS $4.50.

A survey and census of birds observed at the Hanford waste water ponds during an annual cycle are described and evaluated with respect to radioactive waste management. Migration and behavior of waterfowl were given special attention because the Columbia Basin area is an important waterfowl breeding and wintering area. Physical features of the 200 Area waste ponds are described and evaluated with respect to the use and suitability for waterfowl and other birds. Seasonal distributions indicate that all birds observed in the Hanford environs can be classified according to five basic status groups. These are, in decreasing order of numbers of species; migrants; winter residents; summer residents; permanent residents; and accidentals. Summer residents, winter residents, and permanent residents are of greatest importance to waste management because a large portion of their time is spent on and about the ponds. General life history information is described for 106 species of birds observed during the

study period and indicates the relative importance of each species with respect to the radioactivity in the ponds. (auth)

2610 (ESTR-1-72) BACKGROUND REPORT AND BIBLIOGRAPHY FOR A STUDY TO FORECAST NUCLEAR POWER PLANT EFFECTS ON COASTAL ZONES. (EG and G, Woods Hole, Mass. (USA). Environmental Equipment Div.). Sep 1972. 79p. Dep. NTIS $6.00.

The AEC Division of Reactor Development and Technology and two New England power companies (New England Power and Municipal Electric Power Pool) have funded a research program which will apply the recently-developed advanced techniques of deep-ocean oceanography to a coastal zone in an attempt to understand better this important region of the ocean and to predict the environmental impact of nuclear power plants using these waters for cooling and the dispersion of radionuclides. Between Cape Ann, Massachusetts and Great Boar's Head, New Hampshire, lies a stretch of coast line which is primarily a uniform sandy beach. Because there would appear to be a relatively abundant supply of cold water in this area and because it is fairly remote from population centers yet close to major power grids, several power plants have been proposed for this area. This piece of coast line forms part of the southwestern coast of a great indentation in the northeast part of the United States lying between Cape Sable on the east and Cape Cod and Nantucket on the west. The body of water contained within the indentation is known as the Gulf of Maine. The Gulf is roughly rectangular being about 200 miles wide by 120 miles long. The first objective of the work upon which this report is based is to provide background information about the oceanography, meteorology, biology, and geology of the southwestern Gulf of Maine. A second objective of the work leading to this report is to eliminate duplication of effort and promote standardization of methods and interchange of information in coastal zone research and power plant siting engineering. In preparation therefore, steps were taken to become familiar with previous work done in this part of the Gulf of Maine, with ongoing coastal zone research projects, and with the general problems of waste disposal in the coastal zone relating to nuclear power plant siting. A bibliography is included of the material uncovered and reviewed but not directly cited in the main body of the text. (CH)

2611 (NVO-129) CLEANUP SUMMARY REPORT: TATUM DOME TEST SITE, MISSISSIPPI. (Nevada Operations Office (AEC), Las Vegas). Apr 1973. 53p. Dep. NTIS $4.75.

All Tatum Dome Test Site radiation dose levels, which might be potentially hazardous to present and future human surface use, were reduced to the lowest practicable levels, consistent with the applicable guides. The cleanup was accomplished by: sampling and analyzing of soil, water, vegetation, and indigenous animal life from on-site work areas and contiguous off-site areas; excavating and placing all contaminated soil and pumping all contaminated water and other accumulated contaminated fluids into the Tatum Salt Dome nuclear cavity; sealing the cavity by plugging all drilled entry holes with cement; transporting for disposal at NTS all remaining solids (including several types of material), equipment, debris, and other personal property either contaminated or suspected of contamination; and demonstrating that the site has been decontaminated and restored so far as is practicable to provide reasonable assurance that unrestricted use of the site surface will cause no concern in respect to radiological considerations. The Federal Government will retain exclusive right to regulate and control access to the subsurface of the real property, whether by drilling or excavation; and the right to prevent removal of any materials, whether solid, gaseous, or fluid from the real property below the depth of mean sea level. The only possible way for contamination remaining far below the land surface to be redistributed is through the action of ground water. Therefore, only hydrologic monitoring is considered appropriate for a long-term monitoring program. Samples of well, spring, and surface waters will be collected and analyzed primarily from down the hydrologic gradient from the event site. Samples of water from local domestic and municipal use points will also be collected and analyzed. Analyses to be performed include: general chemical (initial run only); tritium, radiochemical for gross beta and gross alpha; and a gamma spectral scan. (CH)

2612 (NVO-746-10) SEISMIC DATA REPORT SOUTHERN NEVADA REGION, DECEMBER 22, 1971-DECEMBER 31, 1972. Bayer, K. C. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Earth Sciences Labs.). Feb 1973. Contract AT(29-2)-746. 221p. Dep. NTIS $13.25.

The seismic data report for the southern Nevada region was prepared for the use of those individuals and organizations having a special need for the individual station data analyzed by the Nevada Special Projects Party (NSPP) of the Earth Sciences Laboratories (ESL). The station data and hypocentral parameters are the result of data scaled only from the local cooperative network and solutions determined by a local epicenter program. Seismic data from announced Atomic Energy Commission (AEC) tests at the Nevada Test Site are also tabulated. (auth)

2613 (UCRL-13568) INVESTIGATION OF FAULTING AT THE LAWRENCE LIVERMORE LABORATORY. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). Dec 1972. 185p. Dep. NTIS $11.25.

For California Univ., Livermore. Lawrence Livermore Lab.

An investigation of faulting in the vicinity of Lawrence Livermore Laboratory was carried out to obtain necessary information in order to provide seismic design criteria in compliance with the Seismic and Geologic Siting Criteria for Nuclear Power Plants of the AEC. Active faults were identified and located in the vicinity of the laboratory. The Tesla fault is the largest active fault that is nearby. The postulated Safe Shutdown Earthquake (SSE) is placed on the Tesla fault at its nearest point to the site. The magnitude of the SSE was estimated, based upon the general geologic environment and the length and other characteristics of the fault. The estimated magnitude is 5.7. Estimation of peak ground acceleration at the site corresponding to this earthquake was based upon recently published data relating to accelerations near faults that have moved during moderate sized earthquakes. The estimated peak ground acceleration is 0.5g. Prior seismic design criteria for a plutonium facility at the Lawrence Livermore Laboratory, which were not intended to comply with reactor siting criteria of the AEC, included an estimated peak ground acceleration of 0.4g. This prior estimate of 0.4g is therefore modified to 0.5g based upon results of this investigation. (CH)

2614 (USGS-474-20) SUBSURFACE TEMPERATURES FROM AMCHITKA ISLAND, ALASKA. Amchitka-16. Sass, J. H.; Moses, T. H. Jr. (Geological Survey, Menlo Park, Calif.). May 1969. Contract AT(2912)-474. 24p. Dep. NTIS $3.25.

Temperatures were measured in four deep holes (UAe-1, UAe-2, UAe-3, and UAe-6h) on Amchitka Island, Alaska. The measurements indicate that hydrologic disturbances to the temperature regime persist to depths of at least 5,000 feet below mean sea level. (auth)

2615 (WASH-1519(Add.)) RIO BLANCO GAS STIMULATION PROJECT, RIO BLANCO COUNTY, COLORADO. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Mar 1973. 173p. (PNE-RB-25). Dep. NTIS $10.75.

The purpose of this document is to appropriately update and supplement the environmental information available on the Rio Blanco Gas Stimulation Project. Since the final Environmental Statement for this project was issued in April 1972, additional experimental programs have been added and some studies better defining the potential environmental consequences of the project have been completed. Project Rio Blanco is a proposed joint government/industry natural gas stimulation experiment located in Northwestern Colorado utilizing three nuclear explosives. The government is not committed to any further nuclear stimulations. The Environmental Statement and this addendum discuss primarily the environmental impact of Project Rio Blanco and is not intended to be a comprehensive statement of the impact of possible future actions. Although additional information developed since April 1972 has enabled additional evaluations to be made of some of the potential effects of the Rio Blanco experiment, these evaluations have only tended to confirm the conclusion as presented in the Environmental Statement, that the Rio Blanco project is the best available alternative, that the benefits of the proposed action outweigh its probable environmental costs, and that the project should be implemented. (CH)

2616 (WASH-1528) FUTURE HIGH LEVEL WASTE FACILITIES, SAVANNAH RIVER PLANT, AIKEN, SOUTH CAROLINA. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Apr 1973. 118p. Dep. NTIS $8.00.

An environmental statement prepared in accordance with the National Environmental Policy Act and in support of the U. S. Atomic Energy Commission's proposals for legislative authorization and appropriations for the design and construction of project 74-1-a "Additional Facilities, High Level Waste Storage, Savannah River, South Carolina", is presented. (CH)

2617 EARTH-SCIENCE STUDIES OF A NUCLEAR TEST AREA IN THE WESTERN ALEUTIAN ISLANDS, ALASKA: AN INTERIM SUMMARY OF RESULTS. Carr, W. J.; Gard, L. M.; Bath, G. D.; Healey, D. L. (Geological Survey, Denver). Geol. Soc. Amer., Bull.; 82: 699-705(Mar 1971).

Recent multi-disciplinary studies by the U. S. Geological Survey conducted on and near Amchitka Island in the Aleutians have contributed much to a better understanding of the geologic, hydrologic, and tectonic environment of the island as an underground nuclear test site. The work included geologic mapping, isotopic dating, deep drilling, geophysical surveys, hydrologic investigations, and

post-test effects examinations. Three distinct volcanic episodes have been distinguished and dated. A general volcano-tectonic history of the arc is proposed. The islands in the vicinity of Amchitka have apparently been stable tectonically in the late Pleistocene and Holocene. Most of the gravity and magnetic data can be interpreted in terms of known structure and rock distribution. Marine geophysical data tend to confirm structural stability of the insular area and indicate a scarcity of sedimentary material on the insular slopes and shelf. Geologic effects of underground tests have been minor. (auth)

2618 SPECTRAL TREATMENT OF ACTIONS OF THREE EARTHQUAKE COMPONENTS ON STRUCTURES. Lin, C. W. (Westinghouse Electric Corp., Pittsburgh). Nucl. Eng. Des.; 24: No. 2, 239-241(1973).

The procedure proposed in a recent paper for applying response spectrum techniques to compute the simultaneous actions of three earthquake components is reviewed. This paper argues that neither such a proposition is necessary, nor is the evidence conclusive enough to justify the change of a practice where the 3-D phenomena of the earthquake has long been recognized. (auth)

2619 FORMULATION OF COUPLED LATERAL–ROTATIONAL FOUNDATION–SOIL INTERACTION OF BUILDING STRUCTURES. Bailey, J. L. (Univ. of Toledo); Raftopoulos, D. D.; Scavuzzo, R. J. Nucl. Eng. Des.; 24: No. 2, 214-231(1973).

An analysis is made of the combined lateral and rocking motion of the foundation of an N-mass structure coupled to a two-dimensional elastic half-space the free-field motion of which simulates an earthquake. The appropriate Lamb problem is solved in terms of integrals convergent in the Cauchy sense and three pairs of Volterra integral equations are derived: one pair neglecting base-mass effects and the other two pairs including them. The Lamb solution appears to be insufficiently smooth to permit the required differentiations of some integrals in two of the pairs of integral equations because of numerical divergence. The integrals known to diverge do not appear in the formulation of the equations which neglect base mass effects. Possible methods of solution are suggested. (auth)

Thermal Effluents

Refer also to abstracts 2561, 2568, and 2982.

2620 (COO-2158-7) INVESTIGATION OF THE INFLUENCE OF THERMAL DISCHARGE FROM A LARGE ELECTRIC POWER STATION ON THE TEMPERATURE AND NEAR-SHORE CIRCULATION OF LAKE MICHIGAN. Quarterly Progress Report, January 1–March 31, 1973. Mortimer, C. H.; Sato, G. K. (Wisconsin Univ., Milwaukee. Center for Great Lakes Studies). 1973. Contract AT(11-1)-2158. 16p. Dep. NTIS $4.00.

2621 (ORNL-TM-4119) STEADY TEMPERATURE DISTRIBUTIONS IN THE FAR-FIELD REGION OBTAINED BY SOLUTION OF THE EQUATION OF CONVECTIVE DIFFUSION IN TWO DIMENSIONS. Dresner, L. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 31p. Dep. NTIS $3.75.

A method based on conformal mapping is suggested for calculating steady, far-field temperature distributions in two dimensions in an arbitrary potential flow field. Two numerical programs for performing the calculations are described and listed, and sample computations are given. (auth)

2622 (ORNL-TM-4160) TRANSIENT COOLING OF A ONE DIMENSIONAL THERMAL PLUME AND ITS APPLICATION FOR DETERMINING COLD SHOCK. Pilati, D. A. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

The abrupt termination of a thermal discharge may cause an impact to aquatic organisms that have been attracted to the discharge's heated water. To assess the cold shock impact, predictions of the transient temperature of the cooling thermal plume are required. An analytical solution is presented for the time-dependent temperature distribution of a one-dimensional thermal plume whose heat source is discontinued. The one-dimensional restriction limits the application of the model to well-mixed rivers and estuaries which might approximate this idealization. Examples of the model's applications are included for an arbitrary initial temperature profile. These examples illustrate how to predict the temperature effects for both mobile and immobile organisms. The sensitivity of the results to various values of the longitudinal dispersion coefficients has been investigated. The results illustrate the fact that the initial rate of temperature decrease is much greater than that predicted from surface cooling alone. Although this work is preliminary in nature, the method developed can be employed, in many cases, to obtain the temperature predictions required for a cold shock assessment. (auth)

2623 PHENOMENOLOGICAL MODEL FOR THE PREDICTION OF THERMAL PLUMES IN LARGE LAKES. Elliott, R. V.; Harkness, D. G. (Hydro-Electric Power Commission of Ontario, Toronto). pp 544-564 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

A mathematical model for the prediction of the size, shape and orientation of the thermal plumes produced by the surface discharge of heated condenser cooling water has been developed. The model is based on the statistical analysis of a series of measurements made on plumes produced by an operating generating station. Arguments are presented to show that the model can be used for prediction purposes at sites other than where the measurements were made. (auth)

2624 PREDICTION OF SURFACE PLUME AREAS ASSOCIATED WITH HEATED DISCHARGES INTO LARGE LAKES: A PHENOMENOLOGICAL MODEL. Frigo, A. A. (Argonne National Lab., Ill.). pp 583-587 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

A phenomenological curve for thermal plume surface areas within isotherms has been developed by Asbury and Frigo (1971). From May to October 1971, temperature surveys of the thermal plumes from several power plants located on Lake Michigan were made by Argonne National Laboratory. The power plants surveyed included the Point Beach Nuclear Power Plant (eleven surveys), the Waukegan Generating Station (two surveys) and the State Line Generating Station (one survey). Areas within surface isotherms were measured and the data plotted on the aforementioned curve. The data points fall within the envelope of data previously plotted by Asbury and Frigo (1971). Thus this new data further strengthens the validity of this curve. (auth)

2625 COMPUTER MODEL FOR PREDICTING THERMAL DISCHARGES IN LARGE LAKES. Hundal, M. S.; Martinek, F.; Henson, E. B.; McLay, R. W. (Univ. of Vermont, Burlington). pp 606-613 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

General mathematical models for predicting power plant thermal discharges in large lakes are presented. The models simulate these effects in three regions: an open channel outfall, a mixing zone close to shore, and a floating plume at a large distance from shore. The effects of mass and energy exchange with the environment are included. The models are used to predict the effects of thermal discharges from the Ginna Nuclear Power Plant on Lake Ontario by using published meteorological and lake data and first hand information on power plant size, etc. The temperatures and flow velocities are computed for the extremes of summer and winter; a decrease in temperature to approximately 1°C at 1000 m is shown. The results are seen to compare favorably with actual temperatures reported in a previous work. The effects of hypothetical cooling towers and cooling ponds are computed and compared with the extreme summer case. Meteorological changes close to the plant are predicted for extreme cases. (auth)

2626 PHYSICAL CHARACTERIZATION OF COOLING WATER DISCHARGES INTO THE ST. CLAIR AND DETROIT RIVERS. Meyers, H. V.; Gessner, J. J.; Waring, T. G. (Detroit Edison Co.). pp.635-641 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

In the summer of 1970 and the spring of 1971, the thermal plumes from four power plants were characterized. Each year, thermal plumes from plants located on the St. Clair River and the Detroit River were studied. A thermal plume was defined as the cooling water discharge detected in the receiving body of water by a measurable temperature difference. The characterization was to determine the spatial dimensions of the plume and to chart the thermal gradients along its path. This work was accomplished using a multiple thermocouple cable and a multipoint recorder to measure vertical temperature transects. Fluorescent dye was used to define the plume area. Transect positions were located by survey triangulation. During the course of the field work, it was found that the ambient water temperature varied from 1.5 to 3°C in 1-2 m of depth and that the variations were repeated in the water column. This data suggested multiple

stratification in the rivers. At the present time, the authors have no explanation for this phenomenon. However, it raises a question concerning the validity of determining the ambient water temperature by single point measurement. In addition, one location in the St. Clair River was observed to have a temperature well below the temperature observed upstream. This suggested a large flow, subsurface discharge of groundwater into the river. (auth)

2627 ANALYTICAL JET-TYPE MODEL OF HEATED WATER SURFACE PLUMES. Stefan, H. (Univ. of Minnesota, Minneapolis). pp 680-688 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

The steady flow of heated water from a straight channel into a lake has been investigated analytically and experimentally. A three-dimensional buoyant jet-type analytical model has been developed to predict the thickness (depth), the main trajectory and the temperature distribution in that portion of a thermal plume where the flow is dominated by the initial momentum and the buoyancy of the discharge and where it has free boundaries. The interaction between turbulent mixing, buoyant spreading and surface cooling is represented in the model. An integral technique using the entrainment principle and the momentum and heat transfer equations is used. Effects of weak crosscurrents and weak winds are also incorporated. The necessary set of equations is solved by forward extrapolation requiring a minimal amount of computer time. The model is not suitable for thermal plumes which cling to a shoreline due to particular wind or current conditions. (auth)

2628 ENVIRONMENTAL QUALITY AND THE THERMAL POLLUTION PROBLEM. Cairns, J. Jr. (Virginia Polytechnic Inst. and State Univ., Blacksburg). pp 829-853 of Careless Technology: Ecology and International Development. Farvar, M. T. Garden City, NY; Natural History Press (1972).

From the careless technology ecology and international development conference; Warrenton, Virginia, USA (8 Dec 1968). See CONF-681233-.

The many simplified ecosystems resulting from man's various activities in the world are inherently much more unstable than the natural ecosystems they replace. This means that wise management of the environment is an increasing imperative if catastrophe is to be avoided. Management must begin with a conception of the environment as an interrelated whole. To come up with a workable method for a single environmental problem without considering the others will, at best, only delay disaster. The rapidly increasing warming of surface waters by industrial uses of water is an example of the urgent need for basic social and policy changes so that proper management of the environment may occur. A detailed discussion is included of present problems and techniques of observing and analyzing changes in ecological patterns in heated waters with studies on the Savannah River and Potomac River cited as examples. Electric power companies and all others using the environment for waste disposal have two alternatives: either to continue to increase stress on the environment and regard the resulting damage as a necessary product of civilization, or manage the environment so it serves the greatest number of beneficial uses. Any attempt to adjust harmoniously with the environment must deal not only with aspects of organizations, attitudes, politics, and values, but with the constant changes of the environment itself. Many of the changes are man-caused, and as they continue to emerge, the ease of past assaults on the various ecosystems gives way to immense difficulties and costs. We need much quicker and more comprehensive techniques to gather and assimilate data on the many related changes before we can work out ways to best integrate our needs and those of the environment. (CH)

Chemical Effluents

Refer also to abstracts 2571, 2572, 2580, 2597, and 4960-4962.

2629 (CONF-721030-, pp 43-50) ANL STEAM PLANT CONVERSION. Puricelli, R. (Argonne National Lab., IL). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25-27, 1972.

The historical sequence of actions taken by Argonne National Laboratory to place its Boiler Plant in compliance with air pollution regulations is reported. The ANL Boiler Plant consists of four Wickes Boilers of 85,000 lbs per hour capacity, fired by Detroit roto-grate coal stokers, and one Wickes Boiler of 170,000 lbs per hour capacity fired by Hoffman roto-grate coal stokers with side firing gas burners as alternate fuel. The boilers produce saturated steam at 200 lbs pressure. The total design steam output is 510,000 lbs per hour. Conversion studies related to the reduction of air pollution and compliance with current regulations were carried out considering the availability of low sulfur coal and recent advances in wet scrubbing technology, the possibility of using L.P. gas, and the possibility of using fuel oils. The conversion of the ANL Plant to multi-grade oil firing proved the most dependable and economic approach to compliance with air pollution requirements. Gas firing capability was included in the conversion proposal as it was estimated that the additional cost would be minimal and there was a possibility gas would become available. (CH)

2630 (CONF-721030-, pp 51-61) SO_x AND PARTICULATE EMISSIONS: Y-12 AND ORGDP PLANTS. Choat, E. E. (Oak Ridge Y-12 Plant, TN). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25-27, 1972.

The major sources of SO_x and particulate emissions at the Y-12 and ORGDP steam plants are discussed. The unique aspects of the two situations and the foreseeable alternative solutions for compliance with air pollution regulations for each site are considered. The Y-12 Steam Plant, built in 1955, consists of four boilers having a capacity of 250,000 pounds per hour each; at 250 psig, and 500°F temperature. The plant was originally equipped to fire pulverized fuel only but was subsequently partially converted to fire both natural gas and pulverized coal. The plant now burns coal during winter months when gas is unavailable. The maximum peak load, projected through 1977, is approximately 770,000 pounds per hour. The supply of gas is ample during summer months to meet the entire plant needs but decreases to zero during winter months. In 1968, electrostatic precipitators were installed as replacement for mechanical collectors originally installed. The steam plant at ORGDP was built in 1942. It has six boilers; three of which have a capacity of 40,000 pounds per hour, the other three have a capacity of 50,000 pounds per hour. The plant operates at a pressure of 100 psig. It was originally equipped with spreader stokers to fire coal. It has no collectors of any type. Subsequent to 1942, two boilers have been converted to fire gas only, and one boiler has been converted to fire both coal and gas. Gas is plentiful during the summer months but is limited to 1,600 M cubic feet per day in the winter. This quantity of gas is sufficient to produce approximately 50,000 pounds per hour of steam. It is current operating practice to use gas in whatever supply available and to supplement this with coal fuel. Two plans are presently being considered for providing additional capacity and a reduction in effluents to meet state regulations. The first plan is to provide new oil-fired equipment in sufficient capacity to meet steam requirements which cannot be provided by gas. As gas is currently cheaper than oil, it would be used when available and supplemented with oil for topping. The second plan is to use hot water which is circulated in the diffusion process to do plant heating which is estimated to be 250,000 M btu/hr. Process steam, approximately 50,000 M btu/hr, would be provided by gas-oil fired boilers. Copious quantities of hot water at 160°F is available for heating and would simply be pumped through the plant, circulated through heating coils, and returned to cooling towers. Both the Y-12 and the ORGDP Steam Plants will require modifications to meet SO_x and particulate emission standards. These modifications are expected to cost from 6 to 10 million dollars. (CH)

2631 (CONF-721030-, pp 97-114) REDUCTION OF NITROGEN OXIDES IN VENT GASES BY SCRUBBING. Pennak, A. F.; Leist, N. R.; Kispert, R. C. (National Lead Co. of Ohio, Cincinnati). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25-27, 1972.

Substantial quantities of nitrogen oxides are formed during production of uranium trioxide (UO_3), nitric acid pickling of uranium recycle metal and chips, and other nitric acid digestions of uranium metals, oxides, and residues. Extensive investigations have been conducted at FMPC to explore the possibilities of more efficient absorption of NO_x from vent gases through the use of improved scrubbing techniques and various scrubbing mediums. Some additives such as caustic have provided somewhat improved scrubbing efficiency as compared with water but utilization or disposal of the accumulated scrubber product has presented distinct offsetting problems. Presently undergoing plant scale testing, 60 to 90 g/l urea in 2 to 3 M HNO_3 at temperatures of 125° to 180° offers greater NO_x removal efficiency than any scrubbing medium previously tested. (auth)

2632 (CONF-721030-, pp 115-121) NO_x ABATEMENT USING AMMONIA WITH ZEOLITE CATALYSTS. Pence, D. T.; Thomas, T. R. (Allied Chemical Corp., Idaho Falls, ID). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

A process is under development in which zeolites are used with ammonia to selectively catalyze the reduction of NO_x. The primary advantages of the process are that the reduction: is selective for NO_x even in oxygen containing effluents; is accomplished at relatively low temperature; is highly efficient; and requires no additional treatment of the effluent before discharge. (auth)

2633 (CONF-721030-, pp 122-133) NO_x RELEASES AND CONTROLS AT THE SAVANNAH RIVER PLANT. Jacobsen, W. R. (Savannah River Lab., Aiken, SC). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

Nitrogen oxide releases at the Savannah River Plant result from three general sources: coal combustion for steam and electricity generation, primarily released as NO; metal cleaning operations in nuclear fuel fabrication processes, released as NO_2 and NO-NO_2-HNO_3 mixtures; and metal dissolution and subsequent chemical processing of irradiated fuel, released from one source primarily as NO_2 and from another as NO. Calculated NO_x ambient air concentrations at the plant boundary resulting from these emissions are within South Carolina State standards. Efforts to minimize releases by off-gas treatment consist of an acid recovery unit on the separations area NO_2 source and a water scrubber on one of the HNO_3 sources in the fuel fabrication area. In the fuel fabrication area, about 50% reduction in NO_x emissions from one particular source was gained by replacement of an acidic metal cleaning operation by a shellblast technique. In addition, concentrations of nitrogen oxides and nitric acid in the immediate vicinity of the fabrication buildings were reduced by installation of 100-ft plastic stacks on all sources in that facility. (auth)

2634 (CONF-721030-, pp 242-244) REMOVAL OF TNT FROM INDUSTRIAL WASTE WATER AT THE BURLINGTON AEC PLANT. Rubin, K. L. (Mason and Hanger-Silas Mason Co., Inc., Burlington, IA). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

This paper is concerned with the activated carbon adsorption process used for removal of TNT from waste water at the Burlington AEC Plant. Developments leading to the present method and an explanation of the operating principles involved are discussed. (auth)

2635 (CONF-721030-, pp 245-290) COOLING TOWER CHROMATE REDUCTION PROGRAM AT THE NRTS TEST REACTOR AREA. Dawson, K. S.; Mousseau, D. R.; Larrick, A. P. (Aerojet Nuclear Co., Idaho Falls, ID). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

Each reactor at the NRTS utilizes conventional cooling towers to reject waste heat to the atmosphere. Blowdown streams from the cooling towers, containing chromate-base corrosion inhibitors, are injected into a disposal well at the reactor area. In an effort to eliminate the release of the toxic chromium compounds to the local aquifer, the chromate concentrations in the cooling towers have been reduced gradually through a series of controlled steps while studies were conducted simultaneously on methods for complete elimination of chromate discharge. The studies included investigation of the concepts of sulfite reduction of Cr^{+6} to the less toxic Cr^{+3} in the blowdown, acidified ferrous sulfate reduction of Cr^{+6} in the blowdown, a strong-base and weak-base ion exchange resin recovery of chromium, lime-soda softening of makeup water and chromate reduction of blowdown, lime-soda softening of makeup and blowdown streams with recycle, lime-soda softening of the blowdown, and the use of alternate corrosion inhibitor system, a commercially available phosphate-silicate-organic system, was selected as an interim measure due to FY-73 AEC budget constraints and was placed into operation in September 1972. A brief description of each of the processes studied and preliminary operating results with the selected system are presented. (auth)

2636 (CONF-721030-, pp 291-331) REMOVAL OF CHROMATE FROM COOLING TOWER BLOWDOWN: PADUCAH AND PORTSMOUTH GASEOUS DIFFUSION PLANTS. Lang, H. A. III (Union Carbide Corp., Paducah, KY); O'Doherty, R. L. Feb 1973.

From AEC Pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

The installation of chromate disposal facilities is planned for the cooling tower blowdown streams at the Paducah and Portsmouth Gaseous Diffusion Plants. The proposed reduction-neutralization-precipitation process, sludge disposal methods, and capital and operating costs are discussed. (auth)

2637 (CONF-721030-, pp 332-343) RECYCLING AND SOFTENING OF RECIRCULATING WATER BLOWDOWN FOR REUSE. Simon, W. K. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

The future of chromium- and zinc-based corrosion inhibitors in open recirculating water systems will depend greatly upon the approved disposal procedures for these elements. The State and Federal regulatory bodies are expected to sanction control standards that will negate the use of chromates and zinc without acceptable disposal methods. Future power loads at the Oak Ridge Gaseous Diffusion Plant will make the disposal of chromate and zinc corrosion inhibitors in the blowdown water mandatory. The capital expenditures and increased operating and maintenance costs associated with ion-exchange and chromate destruction processes have encouraged efforts to find a simpler, less expensive method of removing chromate from the blowdown stream. One of these explorations led to the resoftening of the blowdown water. This report covers the operational results of recycling and blending the recirculating water blowdown with raw makeup water and softening the mixture. The chromate concentration in the blowdown water is unchanged by the softening process and is returned to the recirculating water systems for reuse. The zinc concentration is precipitated as zinc hydroxide and conveyed to the holding lagoon with softener blowdown for settling. This test has proven that excellent calcium hardness reduction can be obtained continuously, utilizing the recycle concept with standard water softening equipment. This is the most economical approach to satisfy operational requirements and pollution abatement regulations. The equipment used in this process is standard water softening equipment used throughout the industry. (auth)

2638 (CONF-721030-, pp 344-352) ANL EXPERIENCE IN CHROMATE REDUCTION. Puricelli, R. (Argonne National Lab., Ill.). Feb 1973.

From AEC Pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

A brief history of chromate usage and discharge at ANL is presented. Research aimed at the reduction of chromate discharge into surface waters is reported. (auth)

2639 (CONF-721030-, pp 353-360) REDUCTION OF LIQUID NITRATE WASTES FROM THE OAK RIDGE Y-12 PLANT. Strohecker, J. W. (Union Carbide Corp., Oak Ridge, Tenn.). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

A proposed system for reduction of nitrate wastes by a recycle mode using physical rather than chemical treatment is under development to handle acid condensates from evaporation systems and raffinates from extraction systems. Recycle of nitric acid and aluminum nitrate to drastically reduce the waste nitrate is the goal of the proposed system. Removal of trace impurities from the recycle stream is the main problem under development. (auth)

2640 (CONF-721030-, pp 376-381) ANL PROPOSED WATER RECYCLE PROJECT. Puricelli, R. (Argonne National Lab., Ill.). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

A water recycling proposal is discussed. Presently the source of cooling water is the Sag Shipping Canal. It is proposed that laboratory and sanitary discharge water be recycled for cooling usage. In addition, potable well water used for once through cooling and now discharged to storm water drains would be reused. (auth)

2641 (CONF-721030-, pp 382-392) NEW HOPE POND DREDGING OPERATION: OAK RIDGE Y-12 PLANT. Sanders, M. (Oak Ridge Y-12 Plant, Tenn.). Feb 1973.

From AEC Pollution Control Conference, Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

The background and experience with an industrial waste treatment pond designed for pH equalization are discussed. The original design provided for a 24-hour liquid retention; however, due to silting and sludge deposits within the pond, the effectiveness of the pond has been reduced by 60 percent. The plans, problems, and solutions for the restoration of this facility by dredging are discussed. (auth)

2642 (ORNL-EIS-73-17) CADMIUM IN THE ENVIRONMENT: AN ANNOTATED BIBLIOGRAPHY. Copenhaver, E. D.; Ulrikson, G. U.; Newman, L. T.; Fulkerson, W. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 444p. Dep. NTIS $24.25.

More than 900 annotated references are included in the bibliography. The references are classified under the following headings: reviews and bibliographies; natural occurrence, mining, and extraction; uses and consumption; pollution of air and water, chemistry, and waste disposal; analytical methods and monitoring equipment; control, abatement, and restoration; and physiological and toxicological aspects in plants, animals, and man. Author, keyword, and permuted title indexes are included. (HLW)

2643 (RLO-2225-T-20-8) MODEL OF THE ACCUMULATION OF FOSSIL CO_2 IN THE ATMOSPHERE AND THE SEA. Fairhall, A. W. (Washington Univ., Seattle. Dept. of Chemistry). 1972. 16p. Dep. NTIS $3.00.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 2210, 2795, 4205, and 4283.

2644 RADIATION MEASUREMENT TECHNIQUES. Wachsmann, F. (Gesellschaft fuer Strahlen-und Umweltforschung mbH, Neuherberg, Ger.). Arch. Tech. Messen; 44: No. 1, 11-14(1973). (In German).

Advances that have been in this field as well as improvements of radiation detectors, spectrometers, and dosemeters are described. Standardization and calibration are also discussed. (GF)

General Detectors and Monitors

Refer also to abstracts 2863, 2864, and 3005.

2645 (AEEW-R-830) CONTROL OF THE COUNTING LABORATORY AT AEE, WINFRITH, BY A SMALL COMPUTER. Taylor, W. H.; Darwall, G. H. D.; Keats, A. B. (Atomic Energy Establishment, Winfrith (England)). Apr 1972. 113p. Dep. NTIS (U. S. Sales Only) $7.75.

The physics and functional requirements for the automatic control of the Counting Laboratory at AEE Winfrith for neutron activation analysis of reactor fuel elements are enunciated and reasons for choosing a small computer as the best means of meeting these requirements are given. Description of the Computer/Laboratory interface system and the software are followed by reports on the commissioning, the operational experience to date, and the proposed future developments of the system. Instructions for operating the current installation are also included. (auth)

2646 (CEA-R-4394) MEASUREMENTS OF RADIOACTIVE GASES. Colomer, J.; Celier, H.; Humbert-Droz, C. (Commissariat a l'Energie Atomique, Bruyeres-le-Chatel (France). Centre d'Etudes). Mar 1973. 54p. (In French). Dep. NTIS (U. S. Sales Only) $4.75.

Various apparatus used to perform measurements of tritium, ^{85}K, ^{133}Xe, ^{14}C, and ^{37}Ar are presented. The measurement methods adopted involve several counting techniques, i.e., internally filled proportional counters, scintillators (SPF, NaI), and liquid scintillators (used for measurements with tritium which can be in the form of water). The equipment used for measurements with limited quantities of gas is described. The counting parameters are defined and evaluated for each technique together with the factors determining the accuracy attainable. In the activity spectrum ranging from 10^{-6} to 10^{-1} μC/cm^3 NTP, an accuracy of between 2 and 5 per cent (depending upon the level of the activity measured) was achieved with a 95 per cent probability. Within the limits of experimental error, the different techniques yield similar results. (auth)

2647 (CONF-721030-, pp 465-479) RUGGEDIZED ULTRASENSITIVE FIELD AIR SAMPLER SYSTEM FOR DIFFERENTIALLY DETERMINING TRITIUM OXIDE AND GAS IN AMBIENT AIR ATMOSPHERE. Robinson, B. (Mound Lab., Miamisburg, Ohio). Feb 1973.

From AEC Pollution Control Conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In Proceedings of AEC Pollution Control Conference, Oak Ridge, Tennessee, October 25-27, 1972.

A practical, ruggedized, tritium field air sampler for simultaneous, differential sampling of the environment for tritium oxide and elemental hydrogen is described. The detection sensitivity approaches environmental tritium background levels. Preliminary data along with the principle of operation for both the collection and desorption system are presented. (auth)

2648 (COO-3333-3) RECENT DEVELOPMENTS IN POSITRON SCINTIGRAPHY. Brownell, G. L.; Burnham, C. A. (Massachusetts General Hospital, Boston. Physics Research Lab.). 1972. Contract AT(11-1)-3333. 49p. Dep. NTIS $4.50.

The use of positron-emitting radionuclides offers unique advantages for radionuclide scintigraphy and also presents unique problems. Positron scintigraphy is of interest for three reasons. First, the detection of the annihilation radiation results in high detection efficiency and high spatial resolution. The reason for this is that absorbing collimators are not an intrinsic part of the imaging system. The second factor is the attenuation characteristics of the annihilation radiation. Since for a given patient thickness the sum of the distance traversed by the two quanta is constant, the attenuation is independent of location of a source positioned between the two detectors. This may aid in visualizing certain details of a radionuclide distribution and offers the possibility of obtaining absolute activity distributions by the use of an external standard. Finally, the unique character of certain positron-emitting radionuclides makes them of interest. Approximately one half of all of the available radionuclides are positron-emitters. Further, the only practical radionuclides for external visualization of the three most important biological elements—carbon, nitrogen, and oxygen—are the three positron emitters, ^{11}C, ^{13}N, and ^{15}O. Recent techniques devised to circumvent limitations present in the design of earlier positron cameras were studied. (auth)

2649 (EUR-4896(Vol.1), pp 267-282) PROTON-RECOIL PROPORTIONAL COUNTER AS A DEVICE TO MEASURE NEUTRON FLUXES AT ENERGIES BELOW 100 keV. Cosack, M. (Physikalisch-Technische Bundesanstalt, Brunswick); Kutscha, M.; Paulsen, A. Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

A γ-n discrimination was used to eliminate the γ-background from recoil spectra measured with a proton recoil proportional counter. The major part of the background could be removed in this way. Spectra were taken for monoenergetic neutrons of different energies below 100 keV produced with the ^{7}Li(p,n)^{7}Be reaction. Different tests show that the γ-n discrimination gives good quantitative results. (auth)

2650 (EUR-4896(Vol.2), pp 915-933) EFFECT OF NEUTRON BACKGROUND ON THE STANDARDIZATION OF NEUTRON FIELDS. Dietze, G.; Jahr, R.; Schoelermann, H. (Physikalisch Technische Bundesanstalt, Brunswick). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Neutron detectors are frequently calibrated by "monoenergetic" standardized neutron fluxes which are always distorted by some non-monoenergetic neutron background. The latter could be accounted for by a more complicated calibration procedure requiring the knowledge of the complete background neutron energy spectra at the different "monoenergetic" calibration energies. Therefore the flux of neutron background was calculated for the experimental hall (dimensions: 30 m × 25 m × 14 m high; target: 6.25 m above ground; thick concrete walls and ceiling) of a pulsed accelerator facility now under construction. The energy distribution as well as the time distribution of the neutron background as a function of the distance between the target and the detector are given. Furthermore, the contributions of the target construction and a gridded aluminium platform, 1.75 m below the target and the detector, were calculated. The results show that the main contribution of fast neutron background at smaller target-detector distances originates in the target, whereas the influence of the concrete shielding walls is not so serious. (auth)

2651 (EUR-4896(Vol.2), pp 935-953) LONG COUNTER AS A SECONDARY STANDARD FOR NEUTRON FLUX DENSITY. Hunt, J. B.; Robertson, J. C. (National Physical Lab., Teddington, Eng.). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

A DePangher type long counter has been adopted as the secondary standard for neutron dosimetry in the United Kingdom. The methods adopted for the calibration of this, and a Motaggart-type long counter, at the NPL are discussed. A brief description of a vanadium bath system used to test the flatness of the response of the long counters in the keV energy region is given. Results are presented for the variation of the counting centers of the counters with energy, and for their efficiencies in the keV energy region. The use of these counters in the calibration of neutron dosimeters is discussed. (auth)

2652 (FRNC-TH-357) UTILIZATION OF ION IMPLANTATION IN THE MANUFACTURE OF SEMICONDUCTOR RADIATION DETECTORS. Application to Position Sensitive Detectors. Waast, B. (Paris Univ., Orsay (France)). 1972. 207p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Ion implantation techniques were used to dope semiconductors. It was demonstrated that precise control of the ion energies, the ion dose, and the annealing temperature enable the properties of the doped zone to be varied over a very wide range. The scanning of the ion beam permits homogeneous doping of large surface samples. Charged particle detectors with high performances were developed: very thick detectors (several millimeters) having an entrance window of several microns extent, obtained by the im-

plantation of Li ions in Si; and contact resistances produced by the implantation of B or P ions in Si for use in the manufacture of position sensitive detectors. A mathematical model describing the operation of these detectors is presented. Tests were carried out on the position resolution of the sensitive diode and on the ballistic deficiency of the amplified signal. The performance and reliability are sufficient for applications in conjunction with accelerators. (FR)

2653 (JEN-246) OBTAINING DEPOSITS OF URANIUM FOR MAKING FISSION CHAMBERS. Artacho Saviron, E. (Junta de Energia Nuclear, Madrid (Spain). Division de Fisica). 1972. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

The preparation of uranium deposits of the required quality for small cylindical fission chambers presents some difficulties. With the method of electroplating described, the uniformity, reproductibility and adherence of the obtained deposits are satisfactory. (auth)

2654 (UCRL-51360) IDENTIFICATION AND MEASUREMENT OF LOW-ENERGY ELECTRONS BY CLOUD CHAMBER TECHNIQUES: THE OXYGEN AND NEON AUGER-ELECTRON PROBLEM. Weston, W. F. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Mar 1973. Contract W-7405-eng-48. 16p. Dep. NTIS $4.00.

A source of monoenergetic x rays was used to produce photoelectrons in an expansion cloud chamber. The incident x rays had energies in the 4.5 to 8.6 keV range. The positive and negative ions composing the photoelectron track were separated by an electric field and the tracks were photographed by two cameras, giving a stereoscopic view of the tracks. The individual droplets in the auger-electron blob or spheroid were counted. The auger spheroid at the high-energy end of the photoelectron track was distinguished from the spheroid at the low-energy end of the track by relative differences in the numerical density of droplets along the track and differences in size of the two spheroids. The data indicate that the small spheroid at the beginning of the track can confidently be identified as the track of auger electrons from either the oxygen or neon atoms. The respective measured energies are 513 ± 75 and 820 ± 54 eV. The expected energies are 514 and 822 eV. (auth)

2655 DETERMINATION OF NEUTRON FLUX AND NEUTRON FLUENCE FROM THE SIGNAL CURRENT OF A SELF-POWERED RHODIUM DETECTOR. Hudritsch, W. W. (Gulf General Atomic Co., San Diego, CA). Contract AT(04-3)-167. Nucl. Technol.; 18: No. 1, 25-28(Apr 1973).

Self-powered neutron detectors are suitable for continuous flux measurements and were used to monitor some of Gulf General Atomic's irradiation experiments in the Engineering Test Reactor in connection with the development of fuel for high temperature gas-cooled reactors. For the purpose of detector current data reduction, the special case of a rhodium detector is analyzed and explicit solutions for the neutron flux and neutron fluence are developed. The solutions describe the time-dependence of flux and fluence for detector irradiation times $\gtrsim$1 h. Independent variables are the detector current and its time derivative, both of which are functions of time. Constants appearing in the equations are the neutron flux, the corresponding electrical current and its time derivative at the time of calibration, the decay constant of ^{104}Rh (4.36 min), and the effective cross section for ^{103}Rh(n,γ)^{104}Rh reactions. (auth)

2656 ANALYTICALLY DETERMINED RESPONSE OF SILICON DETECTORS TO A POLYENERGETIC NEUTRON BEAM. Taherzadeh, M. (California Inst. of Tech., Pasadena). Nucl. Technol.; 18: No. 1, 15-24(Apr 1973).

The response of a 300-μm-thick silicon detector to an incident polyenergetic neutron beam has been evaluated by the use of analytical techniques. The analysis indicates that for neutrons <6 MeV the response of a 300-μm silicon detector to neutrons emanating from a plutonium dioxide (RTG) heat source is basically due to elastic scattering reactions and the contribution from other reactions, i.e., (n,p) and (n,α), is <2%. The contribution from radiative reactions, i.e., (n,γ) and (n,n'γ), is even smaller and therefore is ignored. For neutron energies up to 6 MeV, the maximum response for a 300-μm silicon detector is $<4 \times 10^{-3}$ counts/n within the range of bias energies 25 to 250 keV. If the effects of pulse height defect and the true angular distribution of scattered neutrons are included, the response will be reduced to 1.3×10^{-3} counts/n. (auth)

2657 AIRBORNE γ-SCINTILLOMETER. Christiansen, E. M.; Skaarup, P. (Danish Atomic Energy Commission, Risoe). CAMAC Bull.; No. 6, 6-7(Mar 1973).

A description is given of airborne instrumentation for uranium exploration. The NIM standard is used for the analogue part of the system, and the CAMAC standard for the data collecting part. The system is controlled by a programmable controller with hardware program modules. (EU)

2658 SEMICONDUCTOR RADIATION DETECTORS. Part 1. Information of Siemens A. G., Reaktortechnik. Kuhn, L. (Siemens AG, Erlangen, Ger.). Messtechnik; 80: No. 11, 313-321(1972). (In German).

The recent status of theory and characteristics of semiconductor detectors are described. Several quantities measured and conversion equations for the energy resolution of semiconductors are given. The charge-sensitive amplifier is described. (GF)

2659 INSTANT WORKING LEVEL METER FOR URANIUM MINES. Groer, P. G.; Evans, R. D.; Gordon, D. A. (Massachusetts Inst. of Tech., Cambridge). Health Phys.; 24: No. 4, 387-395(Apr 1973).

The instant working level meter evaluates the working level (WL) in a uranium mine atmosphere within 4 min. Two min are needed to measure the background mostly due to ambient γ radiation and 2 min are spent to measure background plus WL. It has two α channels (RaA and RaC) and one $\beta + \gamma$ channel (RaB and RaC'). The counts in the different channels are multiplied electronically by calculated weighting coefficients and combined to give the WL. No assumptions about Rn daughter equilibrium are made. Only constancy of the radon daughter concentrations in the atmosphere during the time of sampling is assumed. So far a total of 5 instruments of the type described in this report have been built and used in uranium mines. (auth)

2660 COMPARISON OF RADIATION DETECTOR MATERIALS FOR IMAGING APPLICATIONS IN NUCLEAR MEDICINE. Lavoie, L. (Argonne Cancer Research Hospital, Chicago). Phys. Med. Biol.; 18: No. 1, 120-132(Jan 1973).

Forty-two materials representing four classes of radiation detectors including 15 scintillators, 13 Cherenkov counters, 5 semiconductors and 9 wire chambers are compared as detectors of 140 and 500 keV photons. For each material the 140 and 500 keV photon attenuation coefficients and half value thickness, the signal timing and amplitude characteristics, density and approximate cost per cubic centimetre are listed. Photomultiplier tubes and other electronic considerations are mentioned. A keyed bibliography of 105 references is provided. (auth)

2661 TOMOGRAPHIC RADIOISOTOPIC IMAGING WITH A SCINTILLATION CAMERA. McAfee, J. G.; Mozley, J. M.; Stabler, E. P. U. S. Patent 3,714,429. 30 Jan 1973. Filed date 28 Sep 1970. 14p.

A method for tomographic imaging involving the use of a radioisotopic detector comprising a scintillation camera with a multichannel parallel-hole collimator, whose holes are all inclined at an identical angle toward the field of interest, and the moving of this detector in a series of back-and-forth linear motions, centered on a common axis of roatation and with the collimator in reversed orientations, in such manner that the accumulated count rate information can be computed, stored, retrieved and selectively integrated to produce a tomographic image of the radioactive distribution in any selected plane in the field scanned is described. The count rate information is collected and computed in terms of a fixed coordinate system and provides a reservoir of computed data which may be analyzed, utilizing a time-lapse summation technique, to present any particular tomographic plane for imaging. (Official Gazette)

2662 USE OF A ^{226}Ra SOURCE FOR QUICK AND RELIABLE DETERMINATION OF THE EFFICIENCY OF Ge(Li) PHOTON DETECTORS. Demortier, G. pp 431-437 of International Measurement Confederation. II. Schanda, J. (ed.). Budapest; IMEKO Secretariat (1971).

From fifth IMEKO symposium on photon-detectors; Varna, Bulgaria (24 May 1971). See CONF-710564-(Vol.2).

The advantages of ^{226}Ra for efficiency calibration of Ge(Li) detectors are discussed, particularly the fact that ^{226}Ra and its daughter nuclei emit more than 10 γ-rays in the energy interval between 185.7 and 2204 keV with comparable intensities. Geometrical effects in the calibration are discussed, and the relative intensities of the γ-rays of ^{226}Ra using the calibration curves of Ge(Li) detectors are tabulated. (WHK)

2663 γ-RADIATION DETECTORS OF SINTERED CdS. Lakova, M.; Stoyanov, V.; Kanev, S. pp 438-443 of International Measurement Confederation. II. Schanda, J. (ed.). Budapest; IMEKO Secretariat (1971).

From fifth IMEKO symposium on photon-detectors; Varna, Bulgaria (24 May 1971). See CONF-710564-(Vol.2).

The fabrication and properties of CdS doped with various impurities for use as a semiconductor crystal counter for γ detection are discussed. Copper-doped cadmium sulfide showed the best γ sensitivity. Tin electrodes were used and a dc voltage in the 6- to 16-volt range was applied. The average value of the γ sensitivity was 20 to 30 μA/(R/h) cm^2. (WHK)

2664 SHAPE OF PULSE FROM γ-PHOTONS IN Ge(Li) DETECTOR. Antonov, A. S.; Yuskesselieva, L. G. pp 444-450 of International Measurement Confederation. II. Schanda, J. (ed.). Budapest; IMEKO Secretariat (1971).

From fifth IMEKO symposium on photon-detectors; Varna, Bulgaria (24 May 1971). See CONF-710564-(Vol.2).

Equations which describe the charge collection of electrons and holes in Ge(Li) detectors are presented. The theory can be applied to Si(Li) detectors using appropriate values for the electron and hole mobilities. (WHK)

2665 X-RAY DETECTORS BASED ON NEUTRON-ACTIVATED CADMIUM SULFIDE. Mikosza, H. pp 451-457 of International Measurement Confederation. II. Schanda, J. (ed.). Budapest; IMEKO Secretariat (1971). (In German).

From fifth IMEKO symposium on photon-detectors; Varna, Bulgaria (24 May 1971). See CONF-710564-(Vol.2).

Single crystals of CdS were exposed to slow neutron doses of approximately 10^{17} neutrons per cm^2. This activation produced new elements, such as In, Sn, and Cl, within the CdS lattice. Under vacuum, indium electrodes were attached to the activated crystals. Various types of detectors were constructed as shown by diagrams. Because of their small size, the detectors seemed particularly suited for application in medicine where they could be attached to probes. (HBG)

2666 NaI(Tl) SCINTILLATORS AS CONTAMINATION DETECTORS FOR LOW-ENERGY γ EMITTERS. Jansen, K.; Scholz, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 10, 396-397(Oct 1972). (In German).

The suitability of NaI(Tl) scintillators as contamination detectors was tested at γ energies from 30 to 400 keV. It was impossible to establish a single conversion factor which would yield the degree of contamination by multiplication with the counting rate. However, two factors proved satisfactory. One covered the range from 30 to 140 keV (^{125}I, ^{57}Co), and the second applied to the range from 260 to 400 keV (^{75}Se, ^{51}Cr). (HBG)

2667 PARTICLE IDENTIFICATION WITH A SMALL Ge(Li) DETECTOR. Karlsson, L. (Royal Veterinary and Agricultural Univ., Copenhagen). Nucl. Instrum. Methods; 109: No. 1, 101-108(1973).

Investigations on the pulse shapes obtained from a small Ge(Li) detector are presented. A 1 cm^3 planar Ge(Li) detector with a 0.13 mm beryllium window and a 20 nm gold front contact is used. It is demonstrated that electron and γ-ray interactions give rise to two distinct distributions of the risetimes. (auth)

2668 TRITIUM MEASUREMENTS WITH A NEW LIQUID SCINTILLATION COUNTER. Noakes, J. E.; Neary, M. P.; Spaulding, J. D. (Univ. of Georgia, Athens). Nucl. Instrum. Methods; 109: No. 1, 177-187(1973).

A new concept in liquid scintillation counting has been employed in developing an instrument for the purpose of quantitatively measuring low specific activity tritium samples. The instrument design differs from present commercial instrumentation in that it utilizes electronics that measure fast-pulse time intervals rather than performing pulse height analysis. The liquid counter was built to accommodate samples as large as 100 ml of solution. The solutions can be counted as a combination of water and scintillator or as pure benzene synthesized from water. As much as 20 g of water can be counted directly as a solubilized cocktail or an equivalent of 66 g of water converted to benzene. Direct counting of aqueous cocktails can be accomplished to sensitivity levels below 10 T. U. Tritiated benzene samples of 25 ml volume have been counted at 53% counting efficiency with background count rates contributing less than 1.75 c/m. This new instrument utilizes massive graded graded shielding and an electronic guard to minimize external radiation for low background counting. (auth)

2669 HEAVY ION IDENTIFICATION SCHEME BASED ON SEMIEMPIRICAL RANGE-ENERGY CALCULATIONS. Chulick, E. T.; Natowitz, J. B.; Schnatterly, C. (Texas A and M Univ., College Station). Nucl. Instrum. Methods; 109: No. 1, 171-175 (1973).

Particle identification schemes for heavy ions have been tested using the semiempirical range-energy calculations of Northcliffe and Schilling as primary data. A new scheme is suggested in which the particle identifying output (PIO) may be calculated from the relationship $PIO = mE_T + b$, where E_T is the total energy of the particle and m and b are functions of $\Delta E/E_T$, the ratio of the energy loss in the front detector of a detector telescope to the total energy of the particle. Functions for determining m and b are generated using the range-energy tables. The scheme has been compared with other techniques and found to be useful for ions $Z \geq 4$. (auth)

2670 STANDARDIZATION OF A CIRCULAR DISC SOURCE OF β^+ EMITTERS BY THE β^+-ANNIHILATION $\gamma-\gamma$ COINCIDENCE METHOD. Nakajima, T. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 109: No. 1, 125-135(1973).

In the standardization of a circular disc source of β^+-emitters by the β^+-annihilation $\gamma-\gamma$ coincidence method, the corrected geometry factor must be determined accurately. An attempt is made to formulate the factor as a function of the dimension parameters of the experimental setup. However, there is often the case where the parameters are not known accurately. An alternative procedure, i.e., the absorption $\gamma-\gamma$ coincidence method using ^{22}Na is therefore presented to determine the factor experimentally without knowledge of the parameters. The reliability of the experimental method is checked for the standaridization of ^{64}Cu by comparison with the well-type crystal method, and found to be good. Furthermore, each term of the factor is analyzed and determined from comparison of the measured factor with the formulation for it. (auth)

2671 RADIOISOTOPE MONITORING SYSTEM FOR SEWAGE EFFLUENT. Cate, J. L. Jr.; Hoeger, T. O. (Univ. of California, Livermore). Amer. Ind. Hyg. Ass. J.; 33: No. 10, 693-699(Oct 1972).

An automatic, on-line monitoring system for the sanitary sewage effluent from the Lawrence Livermore Laboratory has been constructed. It can detect, at levels lower than USAEC guidelines, all radioisotopes in use at the Laboratory, and it monitors pH continuously. It is wired into a central alarm system which alerts personnel on a 24-h basis. A year's operating experience is summarized, and plans for an improved system are discussed. (auth)

2672 TIME RESOLUTION OF LARGE SCINTILLATION COUNTERS. Nemarov, A. V.; Fel'dman, I. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1351-1352(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 57-58(1972).

A numerical calculation and an experimental investigation were carried out of the time resolution of scintillation counters having large dimensions. (auth)

2673 MULTIFILAMENT NEUTRON DETECTOR OF THE OPEN TYPE FOR A TIME-OF-FLIGHT SPECTROMETER. Vorona, P. N.; Maistrenko, A. N. (Inst. of Nuclear Research, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1340-1342(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 48-50(1972).

A multifilament neutron detector consisting of 32 proportional $^{10}BF_3$ counters of the open type is described. The cathode of each counter forms six aluminum filaments situated around the anode at the vertices of a proper hexagon. The working pressure in the detector is 1050 torr $^{10}BF_3$. (auth)

2674 RELATIVE LUMINESCENCE YIELD OF GAS PROPORTIONAL COUNTERS. Keirim-Markus, I. B.; Savinskii, A. K.; Chaikovskii, V. G.; Yakovlev, A. S. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1337-1339 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 46-48(1972).

The results are presented of measurements of the relative luminescence yield of gas proportional counters filled with Ar, Xe, Kr, Ne, He, He-Xe, Ar + 5% Xe, N_2, H_2, and CH_4. The maximum luminescence yield, just as in gas scintillation counters, corresponds to the 90% He + 10% Xe mixture. The relative luminescence yield of a proportional counter with such a filler exceeds by more than two orders the luminescence yield of a NaI(Tl) crystal. (auth)

2675 MEASUREMENT OF THE OUTPUTS OF PHOTONUCLEAR REACTIONS BY MEANS OF A MULTIFILAMENT PROPORTIONAL CHAMBER. Varlamov, V. V.; Ishkhanov, B. S.; Nesterenko, O. F.; Piskarev, I. M.; Shevchenko, V. G. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1334-1336(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 43-46(1972).

A procedure is described for measurement of yields of photonuclear reactions by means of filamentary proportional chambers. The electronic circuitry used is described, and the experiments are discussed; an analysis of the results is performed. (auth)

2676 PRECISE DETERMINATION OF THE COORDINATES OF PARTICLES IN A PROPORTIONAL CHAMBER. Biryukov, V. A.; Zinov, V. G.; Konin, A. D.; Ponomarev, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1331-1333(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 40-42(1972).

It is shown that in a proportional chamber with potentiometric takeoff of information the measurement of the particle coordinates by means of the cathode electrodes allows errors to be obtained

that are substantially smaller than the distance between neighboring filaments. (auth)

2677 TELESCOPE FOR RECORDING LOW-ENERGY PROTONS IN THE PRESENCE OF AN INTENSE BETA BACKGROUND. Bogdanov, D. D.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1316-1318(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 28-30(1972).

A telescope consisting of two proportional counters and a semiconductor detector is described, which is designed for spectrometry of low-energy protons (0.5 to 6.0 MeV) in the presence of intense β and γ background radiation. The use of coincidences of proportional counters in the control channel substantially reduces the β background of the semiconductor detector in comparison with the case when only one counter is used for control. (auth)

2678 INTEGRATED CIRCUIT SWITCH FOR USE IN ISOTOPE RESEARCH. Lotz, E. van der S. (Stellenbosch Univ., S. Afr.). Agrochemophysica; 3: No. 3, 45-46(1971).

In experiments with short-lived isotopes and for certain statistical tests, it is often necessary to operate a pulse counter many times in succession for relatively short periods. An electronic switch utilizing digital logic techniques and integrated circuits is described, by means of which such counters can be operated repetitively for predetermined periods of 1, 2, 4, 8, 16, 32 or 64 seconds, with "off" periods of 4 seconds between consecutive "on" periods. Timing is derived from mains frequency. Both "on" and "off" periods are accurate within a few milli-seconds, with excellent reproducibility. (INIS)

Radiation Dosimeters

Refer also to abstract 2762.

2679 (AEC-tr-7421, pp 185-189) USE OF THERMOLUMINESCENCE GLASS IKS DOSIMETERS FOR RECORDING THE DOSE OF GAMMA RADIATION IN GAMMA-NEUTRON FIELDS. Kochvar, I. A.; Viktorov, D. V.; Tkachenko, V. V.; Trofimov, V. M. Apr 1973. Translated from Radiobiologiya; 12: No. 6, 938-941 (1972).

The sensitivity of thermoluminescence glass IKS dosimeters to neutrons and γ radiation was investigated. It was shown that the sensitivity of the dosimeters to neutrons, relative to the sensitivity of the dosimeters to γ radiation in the case of the same dose of neutrons and γ radiation absorbed in the tissue is no more than 5% for neutrons with energies up to ~5 MeV. IKS dosimeters can be used to register the dose of γ radiation in the case of radiobiological investigations conducted in γ-neutron fields. (tr-auth)

2680 (CEA-N-1586) APPLICATION OF RADIOTHERMOLUMINESCENT DOSIMETRY TO EXPERIMENTS IN SPACE BIOPHYSICS (EXPERIMENTS CONDUCTED FOR THE WORKING GROUP ON SPACE BIOPHYSICS). Portal, G. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Dec 1972. 15p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

Radiothermoluminescent dosimetry was used for the experiments carried out within the working group on space biophysics. Lithium fluoride activated by magnesium proved to be particularly well suited to the measurements carried out in the biostack taken on board the spacecraft Apollo 16. However, balloon tests carried out at Aire-sur-l'Adour in 1971 showed that this dosimetric material had insufficient performance for that kind of experiments; a new product, calcium sulfate activated by dysprosium was substituted. The results are presented and discussed. (auth)

2681 (EUR-4896(Vol.1)) FIRST SYMPOSIUM ON NEUTRON DOSIMETRY IN BIOLOGY AND MEDICINE, NEUHERBERG/MUNICH, MAY 15–19, 1972. Burger, G.; Schraube, H.; Ebert, H. G. (eds.) (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (West Germany). Institut fuer Strahlenschutz; European Communities, Brussels (Belgium). Commission). Sep 1972. 606p. (In several languages). (CONF-720561-(Vol.1)). EUR B.Fr. 1,000.- (Vols. 1 and 2).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Federal Republic of Germany (F.R. Germany) (15 May 1972).

Thirty-three papers were presented at the conference and included in Vol. I. A separate abstract was prepared for each of 32 papers. The remaining paper was previously abstracted in NSA as 27: 12001. (WHK)

For abstracts of individual papers see: 2649, 2682–2693, 2712–2714, 2766–2769, 2794, 4398–4407, and 4442.

2682 (EUR-4896(Vol.1), pp 211-228) DOSIMETRY MEASUREMENTS IN NEUTRON BEAMS WITH IONIZATION CHAMBERS. Kuehn, H.; Mueller, A. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Frankfurt am Main). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

For the determination of the fast neutron dose several cylindrical ionization chambers with different wall materials have been built. The properties of these chambers regarding phantom dosimetry are described, and the calibration method is discussed. Depth dose measurements for 13.5-MeV neutrons are reported. (auth)

2683 (EUR-4896(Vol.1), pp 229-237) FURTHER DEVELOPMENT OF THE PROPORTIONAL-COUNTER DOSIMETER PROPOSED BY HURST FOR THE NEUTRON DOSIMETRY IN ETHYLENE. Sievers, H. F.; Zill, H. W. (Physikalisch Technische Bundesanstalt, Brunswick). Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The pulse height discrimination method used with the proportional counter dosimeter initially proposed by Hurst, rejects not only small pulses due to secondary electrons from gamma rays but also small pulses due to proton recoils. This gives rise to an error in dose measurement which can be reduced by discrimination between the different kinds of pulses with the same altitude by virtue of their different rise times and selective rejection of the pulses with long rise times. In order to do this, the signal-to-noise ratio of the small pulses and consequently the gas amplification factor must be enlarged. The calibration of the dosimeter by injection of α-particles and total absorption of their well known energy must then be modified. Experimental investigations on this problem are reported. (auth)

2684 (EUR-4896(Vol.1), pp 239-265) INTERCOMPARISON OF FLUX AND IONIZATION CHAMBER MEASUREMENTS OF MONOENERGETIC NEUTRONS IN THE ENERGY RANGE 100 keV TO 15.0 MeV. Dennis, J. A.; Delafield, H. J.; Peaple, L. H. J.; Boot, S. J. (Atomic Energy Research Establishment, Harwell, Eng.). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Two types of ionization chambers were exposed to essentially monoenergetic neutrons in the energy range 100 keV to 15.0 MeV. One type of ionization chamber had conducting walls of "CH' plastic and was filled with acetylene; the other type had walls of graphite and was filled with carbon dioxide. The neutron spectra were measured by a helium-3 proportional counter or by proton recoils and a solid state detector. Neutron fluxes and scattered radiation were measured with uranium-235 fission chambers in boron-10 and cadmium shields. It is shown that the results can only be explained in terms of substantial changes in W values (energy required to form an ion pair) with neutron energy, particularly for carbon dioxide. Corrections due to changes in the effective center of measurement of the ionization chambers and in the wall contribution to the ionization with neutron energy are discussed; also an indication of an error in the knowledge of the nonelastic reaction of neutrons with carbon at higher neutron energies is considered. (auth)

2685 (EUR-4896(Vol.1), pp 283-301) IMPROVEMENTS IN THE SPARK-COUNTING TECHNIQUE FOR DAMAGE-TRACK NEUTRON DOSIMETERS. Cross, W. G.; Tommasino, L. (Chalk River Nuclear Labs., Ont.). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Parameters governing spark counting of etched damage tracks in thin insulating foils were studied with the objective of understanding the conditions that give more accurate and reliable counts. Variables investigated were foil thickness, track diameter, applied voltage, polarity of the thin electrode, air pressure, and time between sparks. The main cause of nonreproducible track counting was found to be double sparking in a track rather than failure of some tracks to pass a spark. The length and slope of the plateau in the curve of counts vs voltage was improved by varying the air pressure during counting in such a way that all sparks occur at nearly the same voltage, by using positive polarity for the thin Al electrode and by controlling the time between sparks. For insulators 10 microns thick, slopes of 1%/100 volts, from 400 to 800 volts, were obtained and the reproducibility of repeated counts with the same insulator was about 0.5% (standard deviation for 10 measurements). The relation found between minimum sparking voltage and air pressure x distance, and between spark energy and the amount of aluminium evaporated, can explain the length of the plateau obtained under varying conditions. Improved track resolution and higher maximum hole densities were obtained in a sparking atmosphere of He. Percentage counting losses were proportional to hole density up to 5000 tracks/square cm, when 10% of the holes were missed. (auth)

2686 (EUR-4896(Vol.1), pp 303-314) IMPROVEMENTS IN THE USE OF NUCLEAR-TRACK DETECTORS IN NEUTRON DOSIMETRY. Faengewisch, G. L.; Scharmann, A. (Univ., Giessen, Ger.). Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

By utilizing (n,f) and (n,α) reactions nuclear track detectors can be used for neutron dosimetry. One main problem is to count very large numbers of tracks. A great deal of work has been done to apply image analyzing computers for automatic counting. Some plastics are suitable for detecting both fission and α-particles. The efficiency and the track density dependence on dose were investigated for Triafol TN. This was carried out for the fission-particles of a ^{252}Cf source and for the α-particles of a ^{210}Po-source. Detecting neutrons is possible via α-particles from an (n,α) reaction, which takes place in the plastic itself or in a converting material placed very close to the detecting foil. For a number of nuclides the (n,α) cross sections are very low respecting thermal neutrons and increase above a characteristic energy in the MeV-region. Thus a rough energy discrimination can be reached by using a combination of materials containing Be, F, and Al as converters. C-recoils and α-particles from (n,α) reactions in the detecting foils make a considerable contribution to the neutron detecting efficiency in the dosimeter combinations. (auth)

2687 (EUR-4896(Vol.1), pp 315-327) THORIUM FISSION FRAGMENT DOSIMETERS IN NEUTRON DOSIMETRY. Heinzelmann, M.; Schueren, H. (Kernforschungsanlage, Jeulich, Ger.). Sep 1972. (In German).

From 1st symposium in neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Personal dose monitoring by means of nuclear track films rarely reveals exposure to neutrons. Fission fragment dosimeters were therefore studied as devices independent of the nuclear track film. Large-surface fission fragment dosimeters with a thin thorium layer are fabricated electrolytically and tested in practical use. They are evaluated automatically, and their sensitivity to fast neutrons is found to be comparable with nuclear track films. The fabrication of the fission fragment dosimeters, their properties (sensitivity, zero effect, direction-dependence and fading) and behavior in practical use are described. When used for personal dose monitoring, the fission fragment dosimeters frequently reveal slight fast-neutron dosage which is not detected by nuclear track films. (auth)

2688 (EUR-4896(Vol.1), pp 329-342) SILICON-DIODE DOSIMETER SYSTEM. Widell, C. O. (Aktiebolaget Atomenergi, Studsvik, Sweden). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The change of the current-voltage characteristics of a small silicon diode is used as a measure of fast neutron dose. This change is permanent and therefore it is possible to integrate doses over a long period of time. Doses from some rad up to several thousand rad can be measured. The information stored is not destroyed during readout. The energy dependence is good between 0.15 and 15 MeV. The diodes are almost insensitive to neutrons of other energies and to beta and gamma. The diode dosimeters are evaluated on a reader which gives a constant current of 25 mA in 0.4 s. (auth)

2689 (EUR-4896(Vol.1), pp 343-365) FAST-NEUTRON DOSIMETRY USING WIDE-BASED n^+pp^+ SILICON DIODES. Wall, B. F. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The characteristics of a wide based n^+pp^+ silicon diode fast neutron dosimeter have been studied over the past 5 years at AWRE, Aldermaston, and those features of this device which make it attractive for radiobiological and medical research are outlined. These include its small size and robustness, simplicity of readout, negligible gamma response and its neutron energy response which closely follows the variation of tissue kerma over the energy range from 300 keV to 14 MeV. The device has already been successfully used in making depth dose measurements in neutron irradiated phantoms and goat carcasses and a possible use is foreseen in the field of neutron therapy treatment. (auth)

2690 (EUR-4896(Vol.1), pp 367-381) COMPARISON OF DOSIMETER PROPERTIES OF DIFFERENT Si DIODES FOR NEUTRON DOSIMETRY. Roesch, E.; Weickelt, G.; Brostroem, D. (AEG-Telefunken, Heilbronn, Ger.). Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

It is shown that for fast neutron dosimetry in the dose range 1 to 1000 rad, Si devices of different type can be used, e.g., PIN-diodes, switching diodes, and photodiodes. Performance data of their radiation sensitive parameter (forward voltage, recovery time, short circuit current) are summarized and compared, and the evaluation equipment is described. The influence of measurement conditions on dosimeter properties is discussed. (auth)

2691 (EUR-4896(Vol.1), pp 383-394) NEUTRON DOSIMETRY BY MEANS OF THE EXOELECTRON EFFECT. Rasp, W.; Siegel, V. (Physikalisch-Technische Bundesanstalt, Brunswick). Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

It is shown that the energy dose of high-energy neutrons in the range from 1 to 14 MeV can be measured by means of the exoelectron effect in sintered BeO. For this purpose a difference method is used. One of the BeO ceramic discs is covered with a layer of polyethylene, the other one with a film of teflon. The additional exoelectron emission from the polyethylene covered disk due to the recoil protons from the radiator layer is a measure for the energy dose of the high-energy neutrons. Measured curves are presented covering a range of 2.5 orders of magnitude for the energy dose of neutrons with mean energies of 4.1 MeV and 14.1 MeV. (auth)

2692 (EUR-4896(Vol.1), pp 395-404) FAST-NEUTRON DOSIMETRY BY MEANS OF TSEE OF BERYLLIUM OXIDE. Laitano, R. F.; Rotondi, E. (CNEN, Rome). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The possibility of using the TSEE properties of beryllium oxide for detecting fast neutrons either alone or in the presence of gamma radiation is studied. The beryllium oxide covered with polyethylene responds to both neutrons and γ-rays. The beryllium oxide covered with material of no hydrogen content responds mainly to γ-rays. Therefore, the response due to the fast neutron contribution is obtained by a suitable subtraction method, as the response to γ-rays for low Z covering materials is rather similar. (auth)

2693 (EUR-4896(Vol.1), pp 405-413) SPECIAL PROBLEMS IN NEUTRON DOSIMETRY WITH MODERATING-DETECTOR SYSTEMS. Rohloff, F. (Kernforschungsanlage, Juelich, Ger.). Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

In the original design of the moderating neutron measurement device with a spherical counter and a thermal-neutron-sensitive detector, it was assumed that the disturbance of the neutron field by the measurement probe could be neglected as it could be compensated by calibration of the measurement device. However, the work of various authors and comparison with measured results, show variations too great to be dismissed as marginal effects. Furthermore, an attempt to minimize disturbance by the use of a small detector can be made only at the expense of a loss of sensitivity. But neutron measurement devices should give reliable indications down to a dose-rate of 1 mRem/h. It is therefore necessary to develop neutron measurement devices containing a relatively large amount of absorbing detector mass, where the pure moderator design is no longer applicable. Computations have already shown that a strong influence is exerted by the absorber or the light ^3He measurement gas on the neutron flux. Attempts to compute the nonlinear effects, caused mainly by the detector system, of the neutron transport in layered moderator spheres are described. These computations are effected with a DTF IV program or with a special program cycle. The first results and their consequences as regards practical dosimetry are reported. (auth)

2694 (EUR-4896(Vol.2)) FIRST SYMPOSIUM ON NEUTRON DOSIMETRY IN BIOLOGY AND MEDICINE, NEUHERBERG/MUNICH, MAY 15–19, 1972. Burger, G.; Schraube, H.; Ebert, H. G. (eds.) (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg bei Munich (West Germany). Institut fuer Strahlenschutz; European Communities, Brussels (Belgium). Commission). Sep 1972. 433p. (In several languages). (CONF-720561-(Vol.2)). EUR B.Fr. 1,000.- (Vols. 1 and 2).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Federal Republic of Germany (F.R. Germany) (15 May 1972).

Twenty-four papers were presented at the conference and included in Vol. II. A separate abstract was prepared for each paper. (WHK)

For abstracts of individual papers see: 2650, 2651, 2695–2697, 2795, 2883, 3526–3529, 4408–4416, 4437–4439, and 4565.

2695 (EUR-4896(Vol.2), pp 663-671) NEUTRON DOSIMETRY AT THE ROSSENDORF CYCLOTRON. Abel, H. (Central Inst. for Molecular Biology, Berlin); Matschke, S.; Regel, K. Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The cyclotron of the Central Institute of Nuclear Research at Rossendorf near Dresden is used as a fast neutron source in radiobiology and radiotherapy. The neutrons are obtained by bombarding a thick Be target with accelerated deuterons (13.5 MeV). Comparative dosimetry includes ionometric methods and threshold-value detectors. As an additional control T2 phages in nutrient media were irradiated by charged particles and fast neutrons. Another dosimetric system (Fricke) was used for the charged particles. The deviations between the dose values measured by the different methods are within ±10%. Treatment planning is founded on the following measurements in a phantom; depth dose curves and dose distributions perpendicular to the beam axis for different field sizes, separately for the neutron, and gamma components. (auth)

2696 (EUR-4896(Vol.2), pp 897-914) CONTRIBUTION TO STUDY OF THE IMPORTANCE OF SCATTERING IN CALIBRATION OF INSTRUMENTS MEASURING THE FLUENCE AND NEUTRON DOSE EQUIVALENTS IN EXPERIMENTAL ROOMS. Vialettes, H.; Cariou, J. M.; Duffar, M. (CEN de Saclay, Gif-sur-Yvette, France). Sep 1972. (In French).

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Measurements were made in rooms 50 to 1,500 m^3 in volume and with (α,n) sources having a mean energy of 0.5 to 4.4 MeV. The results show that the correction of the calibration using standard sources may reach a factor of 3 as to fluence and of 2 as to dose equivalent. In addition, the percentage of fluence diffused can be considered as a constant function of the neutron energy, and varies from room to room as $V^{-\frac{1}{3}}$, V being the volume of the room. As regards the dose equivalent, on the other hand, the volume is not an important factor, and the dose equivalent percentage varies as $(d/R)^{2.17}$, where d is the distance between the source and the detector and R the half-width of the room. Analysis of the results has shown that it is not possible to detect a simple relation between the fluence or the diffused dose equivalent, or the diffused dose percentage or even the diffusion percentage, and simple parameters such as the distance between the source and the detector or the height of the source in relation to the ground, or the ratio between the two. (auth)

2697 (EUR-4896(Vol.2), pp 975-995) CALIBRATION OF MODERATING NEUTRON COUNTERS. Mijnheer, B. J.; Aten, A. H. W. Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Moderating counters consisting of a paraffin or polythene moderator inside of which a thermal neutron detector is placed were calibrated between thermal energies and 15.6 MeV. Corrections were determined for the contribution of scattered neutrons which has been minimized by using a low-scattering environment, for the deviation of the effective center from the geometric center, and for the anisotropy in the neutron emission of the sources. Thermal neutron detectors used within the moderating spheres were BF3-counters, indium and gold foils, and the recording of fission tracks in plastic foil. The change in the response curves of the spheres by inserting a cadmium detector and the moderator, was also investigated. The resulting efficiency curves are compared with published sphere calibrations for the same type of counter or activation detector, and with Bonner sphere sensitivity curves. The measured response curves have been used to obtain a rem-counter or a flat response counter, by means of the multisphere method. (auth)

2698 (FRNC-TH-299) DOSIMETRY OF HIGH INTENSITY ELECTRON PULSES USING AQUEOUS OXALIC ACID SOLUTIONS: CALIBRATION USING AN ABSOLUTE ADIABATIC CALORIMETRY METHOD. Melende, A. (Paris Univ., Orsay (France)). 1971. 69p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Paris Univ., Orsay (France). Faculte des Sciences.

The physical parameters relevant to the use of adiabatic calorimetry for the measurement of radiation doses were studied together with the radiolysis effects of electron pulses in aqueous oxalic acid solutions. The experimental equipment used is described, i.e., pulse radiation source (Febreton 707: 2 MeV electron accelerator); calorimetric techniques (different thickness Al plates), dosimetry (irradiation cell for aqueous oxalic solutions, analysis by gas chromatography of the CO_2 and H_2 formed by radiolysis). The experimental results obtained using calorimetry are given. The way in which these results are used to calibrate the chemical dosimeter is described. It was observed that the formation yield of CO_2 in degassed solutions is about 20% less than that obtained with aerated solutions. A yield $G(CO_2) = 1.90 \pm 0.10$ is expected for dose rates greater than 10^{19} eV $.g^{-1}.s^{-1}$ and for degassed 500 mM solutions. (FR)

2699 (RD/B/N-2539) AUTOMATIC FILM BADGE READER USING A PROGRAMMABLE DESK CALCULATOR. Hill, M. J.; Walker, W. N.; Waring, D. F. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Dec 1972. 53p. Dep. NTIS (U. S. Sales Only) $4.75.

The design, construction, and method of operation of an automatic film badge reader are described. The instrument uses a WANG 700C programmable calculator interfaced to a film badge reader head to provide an automatic print out of apparent dose for each of the six areas of a badge, also x-ray, beta, slow neutron, and gamma doses. (auth)

2700 RADIATION CONTROL. Arakawa, N. (Chiyoda Safety Appliance Co. Ltd., Tokyo). Yosetsu Gijutsu; 20: No. 9, 63-67 (Sep 1972). (In Japanese).

In nondestructive inspection using radiation, radiation control must be established in order to prevent radiation exposure. The actual conditions of radiation exposure dose classified by occupation were investigated, and those results indicated that the annual exposure dose of more than 87% of the persons concerned was less than 500 mR. Those whose annual exposure dose was more than 1.5 R are largely engaged in the nondestructive inspection. Individual monitors used for x rays, γ rays, and fast neutrons are film badges, pocket chambers, thermoluminescence dosimeters, and fluorescence glass dosimeters. In the selection of the dosimeters, it is necessary to evaluate particular characteristics of the dosimeters. From the view point of the number of users, there are more film badges than other dosimeters. A manual on the measurement of the individual exposure dose has been reported. Radiation control has two objectives; individual control and environmental control. The environmental control involves four main operations. The first is the establishment of a control and warning area, the second, environmental monitoring, the third, the control of radiation sources, and the fourth, evaluation of working conditions. The individual control involves two operations. They are individual monitoring and health examination. (JA)

2701 PERSONAL RADIATION ALARM MONITOR FOR NONDESTRUCTIVE INSPECTION IN FACTORIES. Yoshizawa, Y.; Morimoto, K. (Tokyo Univ.). Genshiryoku Kogyo; 18: No. 11, 29-32(Nov 1972). (In Japanese).

For the workers in nondestructive inspection shops, e.g., in thermal power plants, personal radiation alarm monitors have been developed. The equipment carried by the workers consists essentially of two GM tubes with directional sensitivity, associated components, and an alarm system. The alarm system functions in two stages, i.e., flashing of a blue lamp for over 0.6 mR/h; and flashing of a red lamp for over 2 mR/h or sounding of a buzzer for over 10 mR/h, these two being optional by switching. Application of the equipment in one of the abovementioned plants has been proved to be successful. In connection with the development of the monitors, aspects concerned are also explained, such as means of alarming, step-wise alarming, direction dependence and energy dependence, response time for the alarming, etc. (JA)

2702 INFLUENCE OF TEMPERATURE ON THE SENSITIVITY OF SILICON SURFACE BARRIER DETECTORS USED FOR X- AND γ-RAY DOSIMETRY. Petushkov, A. A.; Parker, R. P. (Royal Marsden Hospital, Sutton, Eng.). Phys. Med. Biol.; 18: No. 2, 235-245(Mar 1973).

The performance of silicon dosemeters is greatly affected by the ambient temperature. The expected variation in sensitivity with temperature is considered and compared with experimental results for a number of coaxial and planar devices; certain anomalies are observed at low dose rates for load resistances less than about 100 k Ω. It is suggested that these are largely due to thermoelectric EMFS arising from small (<1°C) temperature differences between different parts of the system. The choice of input impedance, the sensitivity obtained and the effect of mains pick-up are also considered. (auth)

2703 THERMOLUMINESCENT LITHIUM FLUORIDE. Portal, G. (to Commissariat a l'Energie Atomique). French Patent 2,123,889. 15 Sep 1972. Filed date 4 Feb 1971. 4p. (In French).

A new industrial product is presented: a lithium fluoride containing traces of activating elements rendering it useful for thermoluminescent dosimetry and in addition 0.4 to 5% of Na and/or 1 to 10% of K (in the form of fluorides). The product is intended for radiation protection applications. (FR)

2704 RADIOPHOTOLUMINESCENT GLASS WITH IMPROVED DOSIMETER PROPERTIES. Kaes, H. H. (Leitz GmbH, Wetzlar, Ger.). Glastech. Ber.; 46: No. 1, 7-11(1973). (In German).

The technological and dosimetric properties of a newly developed

fluoride-based photoluminescent glass are described. The technology of this durable dosimeter requires less energy consumption and is less susceptible, as far as predose is concerned, to increased impurities than the common metaphosphate based dosimeter glass. The replacement of metaphosphate groups by fluoride decreases the average coordination number and thus the γ-energy dependence of the dosage indicated which becomes energy-independent for sufficiently small activator concentrations. At the same time, the recorded dosage is made more stable against ultraviolet light and thermal effects. Sensitivity passes through a maximum in relation to activator concentration. The glass developed records dosages of 0.1 R with an error of ±15% almost independently of γ-energy and free from fading up to 100°C. (GF)

2705 BIBLIOGRAPHY OF THERMOLUMINESCENT DOSIMETRY (1968-1972). Spurny, Z.; Sulcova, J. (Radiologicka Dozimetrie Ustavu Jaderneho Vyzkumu, Prague). Health Phys.; 24: No. 5, 573-587(May 1973).

A bibliography of 450 references of thermoluminescent dosimetry covering the years 1968 to 1972 is presented. (UK)

2706 NOVEL TRACK ETCH TECHNIQUE FOR NEUTRON MEASUREMENTS. Robinson, J. E.; Kehrer, M. L. (Univ. of Maryland, Baltimore). pp 497-503 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The use of dielectric track detectors sandwiched between fission foils for measuring low levels of neutron flux in association with pulsed photon or electron beams from a medical betatron is discussed. (WHK)

2707 THERMOLUMINESCENCE IN CONCRETE MEASUREMENTS FOR DETERMINING γ-RAY TRANSMISSION CURVE AND BUILD-UP FACTORS. De Franceschi, L.; Gentili, A.; Sabbatini, V. (Servizio di Fisica Sanitaria, Pisa, Italy). Nucl. Instrum. Methods; 109: No. 1, 25-27(1973).

The ^{60}Co transmission curve and build-up factors in concrete shieldings were determined by measuring TL in the concrete itself. Since with this technique, concrete is "itself" a dosimeter, the real absorbed dose is measured. Comparisons are made with data reported in literature and the good agreement confirms the validity of the technique. (auth)

2708 RADIATION-RESISTANT GAMMA-DOSIMETERS BASED ON CdS SINGLE CRYSTALS WITH COMPENSATED IMPURITIES. Kopas, N. F.; Galushka, A. P.; Konozenko, I. D. (Inst. of Nuclear Research, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1353-1354(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 59-60(1972).

A description is given of the γ dosimeters based on CdS single crystals with compensated impurities which allow measurement of the intensity of ^{60}Co γ radiation ranging from 0.1 to several thousand roentgens per second with an error not exceeding ±5%, up to an integral dose of 10^5 R. An increase in radiation stability of the γ sensitivity of CdS single crystals is achieved by doping them with the following impurities during the growth process: 0.5% Ag and 0.1% Ga (by weight). The impurities were added to the original CdS powder. The construction and principal characteristics of the γ dosimeters are presented. (auth)

2709 NEUTRON DOSIMETER BASED ON FISSIONING ISOTOPES. Keirim-Markus, I. B.; Koshaeva, K. K.; Kraitor, S. N.; Kushnerev, A. Ya. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1355-1357(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 61-63(1972).

A neutron dosimeter is described which uses a set of fissioning isotopes. The efficiency of the dosimeter reproduces the dependence of the surface equivalent to the dose on the neutron energy. The schematic of the dosimeter and the results of measurements in neutron fields having the various spectra are presented. The scatter of the value of the dosimeter pulse for fission-neutron spectra behind shielding consisting of water, water plus lead, iron, and iron polyethylene does not exceed 3%. The results of the measurements are in agreement with calculated data. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 2126, 2794, and 3786.

2710 (ANCR-1103) RALPH: AN ONLINE COMPUTER PROGRAM FOR ACQUISITION AND REDUCTION OF PULSE HEIGHT DATA. Davies, R. C.; Clark, R. S.; Keith, J. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Apr 1973. Contract AT(10-1)-1375. 427p. Dep. NTIS $10.60.

A background/foreground data acquisition and analysis system incorporating a "high level" control language has been developed for acquiring both singles and dual parameter coincidence data from scintillation detectors at the Radiation Counting Laboratory at the NASA Manned Spacecraft Center in Houston, Texas. The system supports acquisition of gamma-ray spectra in a 256 × 256 coincidence matrix (utilizing disk storage) and simultaneous operation of any of several background support and data analysis functions. In addition to special instruments and interfaces, the hardware consists of a PDP-9 with 24K core memory, 256K words of disk storage, and DECtape and Magtape bulk storage. (auth)

2711 (COO-2231-11) ENERGETIC-NEUTRON SPECTROMETRY. Progress Report, 1 April 1972-31 March 1973. Madey, R.; Waterman, F. M. (Kent State Univ., Ohio). [nd]. Contract AT(11-1)-2231. 12p. Dep. NTIS $3.00.

The self-contained time-of-flight spectrometer has been used successfully to measure neutron spectra from both thick and thin targets. Neutron spectra produced by 740 MeV protons on a 30-cm thick uranium target have been measured from 20 to 500 MeV at 50 degrees and from about 2 to 140 MeV at 130 degrees. Comparison of these results with the predictions of the nucleon-meson transport code (NMTC) shows that the intranuclear cascade model underestimates the production of cascade neutrons at wide angles; furthermore, these comparisons show that this discrepancy increases with increasing angle of emission. The high-energy limit of the spectrometer has been extended to about 1 GeV by adding a counter telescope to detect the recoil proton from the n-p elastic scattering event in the first detector. Neutron spectra above about 175 MeV produced by 724 MeV protons on thin beryllium and copper targets have been measured at 0 degrees with this modified spectrometer. Comparison of these results with the intranuclear cascade calculation indicates that the intranuclear cascade model underestimates the neutron production both in the quasi-elastic peak and in the continuum between 300 MeV and the 175 MeV cut-off energy of the spectrometer. (auth)

2712 (EUR-4896(Vol.1), pp 415-433) SPECTROMETRY OF FAST NEUTRONS BY DIFFERENT METHODS. Schraube, H.; Eckl, W.; Kolbe, K.; Burger, G. (Gesellschaft fuer Strahlen-Umweltforschung m. b. H., Neuherberg, Ger.). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Two different devices are used for the spectrometry of fast neutrons in the Institut fuer Strahlenschutz. One is a scintillation spectrometer which uses organic scintillators and pulse shape analysis technique, while the other is a thin radiator telescope with solid state detectors. Apparatus and experimental techniques are compared with respect to their main spectrometric features, such as particle discrimination, energy resolution, and range of neutron energy to be detected. In this regard, the determination of the true response functions and their influence on the neutron spectrum, which is unfolded from the measured data, is discussed. Results are shown for the spectrometry of a 5 Ci Am-Be neutron source for both techniques. (auth)

2713 (EUR-4896(Vol.1), pp 435-446) MEASUREMENT OF NEUTRON SPECTRA IN HIGH-INTENSITY γ FIELD. Van Der Zwan, L.; Geiger, K. W. (National Research Council, Ottawa). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The ability to separate neutron and γ events in a proton recoil detector depends on the inherent pulse shape difference and the number of photoelectrons produced by the two types of excitations of the scintillator. Inclusion of pulse pile-up rejection in the pulse shape discriminator becomes important when high γ to neutron ratio together with high counting rates is experienced. The limitations of the technique are not clearly defined because they are related to the magnitude of errors which can be tolerated and critically depend on the lower energy limit of events detected. Stilbene and NE 213 and NE 218 scintillation detectors are discussed. (auth)

2714 (EUR-4896(Vol.1), pp 457-467) SIMULTANEOUS DETERMINATION OF THE ENERGY AND THE DIRECTION OF FAST NEUTRONS. Bortfeldt, J. (Physikalisch-Technische Bundesanstalt, Brunswick). Sep 1972. (In German).

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

In neutron dosimetric studies a knowledge of the spectral distribution of neutron current density often is necessary. It is shown that a modified ^{6}Li-sandwich-spectrometer can be used to measure energy and direction of a fast neutron simultaneously, provided that the differential cross section is known as a function of the neutron energy. If this condition is fullfilled only at some discrete energy values the course of the cross section function

can be determined by using the same measuring device in a continuous neutron spectrum of neutrons, e.g., at the end of a reactor beam tube. (auth)

2715 (FEI-351) BASIC CHARACTERISTICS OF A DIFFERENTIAL, SINGLE-CRYSTAL SCINTILLATION NEUTRON SPECTROMETER. Trykov, L. A.; Tyufyakov, N. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The dependence of pulse form, produced in organic crystal scintillators during excitation by heavy charged particles was studied with respect to the role of the direction of motion of the particle in a scintillator. The possibility and advantage of utilizing this effect for the solution of a series of problems in the spectrometry of ionizing radiation are demonstrated in particular for fast neutrons. (tr-auth)

2716 (KHFTI-72-40) MULTI-CHANNEL COUNTER FOR THE DETECTION OF HIGH ENERGY ELECTRONS. Polishchuk, V. N.; Shevchenko, N. G.; Afanas'ev, N. G.; Buki, A. Yu.; Vladimirov, Yu. V.; Vuitsik, V. I.; Likhachev, V. P.; Fainzil'berg, S. D. (Akademiya nauk Ukrainskoi SSR, Kharkov. Fiziko-Technicheskii Institut). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A multichannel counter is described which was designed for high-energy electron detection at the exit of the SP-95 magnetic spectrometer. The counter consists of ten scintillation detectors arranged in the focal plane of the spectrometer which is linked to the coincidence of a Cherenkov detector. Each scintillation detector has a pulse resolution of 0.31% as fixed by the width and dispersion of the spectrometer. The total capture associated with a pulse is 4.5%. The dead time of the fast logical circuit was 45 nsec. (tr-auth)

2717 (LA-5203-MS) LOS ALAMOS FIELD PULSE-HEIGHT ANALYZER. Hiebert, R. D.; Johnson, L. J.; Koelle, A. R. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $3.00.

A portable nuclear radiation spectrometer has been designed for rapid field measurement of mixed isotopic contaminants. The instrument can simultaneously accumulate counts in six energy channels. The first application of the spectrometer used a low energy photon scintillation detector, but the instrument can be adapted to other types of detector probes. (auth)

2718 (N-72-33378) PRELIMINARY DESIGN STUDY FOR A COSMIC X-RAY SPECTROMETER. Final Report. (Massachusetts Inst. of Tech., Cambridge. Center for Space Research). 1 Jul 1972. Contract NAS8-24585. 127p. (NASA-CR-123910). NTIS.

The results are described of theoretical and experimental investigations aimed at the development of a curved crystal cosmic X-ray spectrometer to be used at the focal plane of the large orbiting X-ray telescope on the third High Energy Astronomical Observatory. The effort was concentrated on the development of spectrometer concepts and their evaluation by theoretical analysis, computer simulation, and laboratory testing with breadboard arrangements of crystals and detectors. In addition, a computer-controlled facility for precision testing and evaluation of crystals in air and vacuum was constructed. A summary of research objectives and results is included. (STAR)

2719 (N-73-12699) COMPARISON OF NEUTRON SPECTRA MEASURED WITH THREE SIZES OF ORGANIC LIQUID SCINTILLATORS USING DIFFERENTIATION ANALYSIS. Shook, D. F.; Pierce, C. R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov. 1972. 29p. (NASA-TM-X-2646). NTIS.

Proton recoil distributions were obtained by using organic liquid scintillators of different size. The measured distributions are converted to neutron spectra by differentiation analysis for comparison to the unfolded spectra of the largest scintillator. The approximations involved in the differentiation analysis are indicated to have small effects on the precision of neutron spectra measured with the smaller scintillators but introduce significant error for the largest scintillator. In the case of the smallest cylindrical scintillator, nominally 1.2 by 1.3 cm, the efficiency is shown to be insensitive to multiple scattering and to the angular distribution to the incident flux. These characteristics of the smaller scintillator make possible its use to measure scalar flux spectra within media where high efficiency is not required. (auth) (STAR)

2720 (SRARI-P-165) POTENTIALITIES AND APPLICATION OF THE METHOD OF GAMMA-SPECTROMETRY IN MATERIAL INVESTIGATIONS. Davydov, E. F.; Ivanov, V. B.; Sukhikh, A. V.; Shiplov, V. I. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 31p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

The potentialities and applications of semiconductor gamma spectrometry techniques in irradiated material investigations are considered. A block-diagram is presented of a versatile Ge(Li)-gamma spectrometer which may have various modes of operation, namely, it may operate as a monocrystal, as an anti-Compton, or a summing Compton spectrometer. The methods used are briefly considered, and some particular results are cited. (auth)

2721 (UCRL-51307) LLL ELECTRON AND PROTON SPECTROMETER ON NASA'S ORBITING GEOPHYSICAL OBSERVATORY 5 (THE DATA USER'S GUIDE TO THE MICROFILM RECORDS). West, H. I. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 20 Dec 1972. Contract W-7405-eng-48. 60p. Dep. NTIS $5.45.

Background is provided for using data from the LLL energetic-particle experiment conducted on OGO-5. These data have been plotted on both 20-minute and 2-hour scales. Data from the UCLA magnetometer experiment have been plotted to the 20-minute scale for correlative purposes. In addition, tables of pertinent attitude-orbit data have been plotted. Many of these data are available on microfilm from the National Space Science Data Center. (auth)

2722 CAMAC SYSTEM FOR COMPUTER CONTROL OF SPECTROMETERS. Howells, M. R. (Univ. of Manchester, Eng.); Munro, I. H.; Naylor, L. CAMAC Bull.; No. 6, 3-5(Mar 1973).

An automated control system for optical spectrometers is described. Each spectrometer is controlled by a CAMAC crate, and the crates are driven as a branch by a Honeywell 316 computer. Users specify spectrometer operations by typing parameters on the keyboard of a television monitor. The operations are carried out automatically, and the data are displayed. (EU)

2723 COMPUTER ANALYSIS OF γ-RAY SPECTRA FROM SEMICONDUCTOR DETECTORS. Katou, T. (Inst. of Physical and Chemical Research, Wako, Japan). Rikaguku Kenkyusho Hokoku; 48: No. 6, 166-174(Nov 1972). (In Japanese).

A data-analyzing code for computer analysis of γ-ray spectra from Ge(Li) detector systems has been built for FACOM 270-30 which is adjustable to a medium-sized electronic computer. It provides the following functions: data smoothing, peak searching, background subtracting, fitting with the shape function, determination of the total absorption peak energy and intensity, and data-plotting. The code has been used with a variety of spectra from Ge(Li) detectors of varying resolution and active volume. (auth)

2724 USE OF ACCELEROMETERS IN MOESSBAUER SPECTROSCOPY. Waeppling, R.; Pernestal, K. (Uppsala Univ.). Nucl. Instrum. Methods; 109: No. 1, 1-2(1973).

A study has been made of the feasibility of accelerometers as controlling devices in Moessbauer drive systems. It is shown that the use of parabolic or constant acceleration motion gives some problems while a sinusoidal motion is controlled with ease. It is suggested that the use of accelerometers close to the source or absorbers driven by long pushrods in cryostats might increase the resolution of the spectrometers. (auth)

2725 TECHNIQUE FOR INVESTIGATING CONTINUOUS PHOTON DISTRIBUTIONS. Jones, R. T.; Ljubicic, A.; Logan, B. A. (Univ. of Ottawa, Ont.). Nucl. Instrum. Methods; 109: No. 1, 77-81(1973).

A technique which is suitable for investigating photons with a continuous energy distribution is described. The experimental arrangement involves a Compton spectrometer with the two detectors of the spectrometer operated in a two dimensional pulse height analysis system. The technique is applicable to photon energy regions above 50 keV. (auth)

2726 HIGH RESOLUTION, LARGE VOLUME Ge(Li)-NaI(Tl) COMPTON-SUPPRESSION SPECTROMETER. Konijn, J.; Goudsmit, P. F. A.; Lingeman, E. W. A. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Instrum. Methods; 109: No. 1, 83-92(1973).

A Compton-suppression spectrometer is described, consisting of a NaI(Tl) crystal (ϕ 254mm, length 229mm) and a 15% closed-end Ge(Li) detector. The Compton-suppression factor is 9.5; energy resolution and peak-Compton ratio for the 1.33 MeV ^{60}Co radiation are 1.92 keV fwhm and 420 respectively. In the 100 keV region the resolution is 0.92 keV fwhm. Examples are given of the use for detection of complex γ-ray spectra, of application as an "energy-level spectrometer" and of application for very low-level counting. (auth)

2727 DESIGN AND PERFORMANCE OF A NEW MAGNETIC SPECTROGRAPH FOR ACCURATE ENERGY MEASUREMENTS. Goss, J. D.; Rolliefson, A. A.; Browne, C. P. (Univ. of Notre Dame, IN). Nucl. Instrum. Methods; 109: No. 1, 13-23(1973).

A large broad-range magnetic spectrograph of a new design is

described. The primary requirement of accuracy is achieved with a single dipole magnet, fixed focal surface and high dispersion. A large energy range of $E_{min}/E_{max} = 3.7$, a solid angle up to 2.8 msr in the normal mode, and an energy resolution greater than 3000 over much of the range make it an excellent instrument for reaction energy measurements. The design, construction and testing are described. (auth)

2728 CONSIDERATION OF CASCADE TRANSITIONS IN DETERMINING THE ABSOLUTE YIELD OF γ RAYS. Andreev, D. S.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh. (Physical-Technical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1358-1360(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 63-65(1972).

The connection between the actual and equipment yields of γ rays in the case of complex decay diagrams is considered. The calculation takes into account the presence of cascade transitions (sequential and parallel relative to those considered) and allows refinement of the excitation cross sections of the nuclear levels in the investigation of nuclear reactions via the recording of γ quanta. (auth)

2729 RESONANCE COUNTER FOR OBSERVING THE MOESSBAUER EFFECT IN ^{125}Te NUCLEI. Lebedev, V. A.; Bakov, E. K.; Kuz'min, A. I.; Babeshkin, A. M. (Moscow State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1346-1348 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 53-55(1972).

A resonance counter for observing the Moessbauer effect in ^{125}Te nuclei is described. The counter records secondary x-ray and γ radiation, but not all of the counter readings are associated with resonance absorption of radiation. This leads to the necessity of replacing the "=" sign by a ">" sign in the conventional procedure for determining the efficiency (η) of the counter and the ratio (ϵ) between useful counter and background count. For a scatterer having a thickness of 8.5 mg/cm^2 of ^{125}Te, we have $\eta \gtrsim 30\%$, while $\epsilon \gtrsim 100\%$. (auth)

2730 SCINTILLATION RESONANCE DETECTOR FOR MOESSBAUER INVESTIGATIONS. Murin, A. N.; Bondarevskii, S. I.; Dzhurzha, V. V.; Tarasov, V. A. (Leningrad State Univ.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1349-1350 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 55-56(1972).

A highly efficient scintillation resonance detector was fabricated for the 23.8-keV transition in ^{119}Sn. The dependence of the magnitude of the experimentally observed effects on the distance between the source and the detector is revealed and explained. (auth)

2731 MOESSBAUER SPECTROMETER WITH A REVERSING ADDRESS REGISTER OF THE MULTICHANNEL ANALYZER. Ponomarchuk, V. L.; Romanov, V. P. (Physical-Technical Inst. of Low Temperatures, Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1309-1352(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 31-33(1972).

A Moessbauer constant-acceleration spectrometer is described which was created on the basis of an AI-256-1 analyzer whose address register was replaced by a reversing register. The combination of a reversing counter in the address register with a triangular reference signal shaped by a precision digital-to-analog converter allowed the use of not only the "forward" but also the "reverse" traverse of the vibrator to be used for collection of information and permitted the "sag" of the spectrum to be eliminated. The use of an original circuit for stabilizing the drift of the drive amplifier, which was encompassed by 100% dc negative feedback, allowed an integral velocity nonlinearity not exceeding 0.02% to be obtained. The temperature drift of the velocity did not exceed 0.01% per degree. (auth)

2732 FIRST SERIES OF MEASUREMENTS WITH THE HEIDELBERG Q3D MAGNETIC SPECTROGRAPH. Wiedner, C. A. (Max Planck-Institut fuer Kernphysik, Heidelberg). (1972). 9 p. (In German).

From spring meeting of the German Physiology Society; Berlin, Germany (20 Mar 1972).

The required specifications of the spectrograph are given, the ion optical concept is outlined, the technical realization is described, and results of field measurements are given. The resolution power has been determined using ^{252}Cm α-beams and 25 MeV ^{3}He–Au scattering. (INIS)

High Energy Physics Instrumentation

Refer also to abstract 3512.

2733 (CERN-Trans-72-18) PROBLEM OF IMPROVING A CRT UNIT WITH HIGH RESOLUTION FOR SCANNING AUTOMATIC UNITS. Utochkin, B. A.; Rabin, B. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Sep 1972. Translated by R. Luther of IFVE-SPK-71-92. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Methods of decreasing focusing aberrations and deflections in a cathode ray tube of high resolving ability are described. The system has an application as a light spot generator for automatic scanning and processing photographs of a track chamber. New tubes with high voltage compression of the electron beam and tubes with a quasi-laminar electron beam simplify the approach to the production of nodal points of the cathode ray tube since they eliminate the necessity of complex dynamic corrections in focusing and astigmatism. The technical characteristics are thereby improved, and the reliability of the tube nodal points is enhanced. (tr-auth)

2734 (DESY–73/7) DESCRIPTION AND PERFORMANCE OF AN INTERACTIVE BUBBLE CHAMBER ANALYSIS SYSTEM USING AN HPD. Mueck, H. J.; Nagel, H. H.; Selonke, F. (Deutsches Elektronen–Synchrotron, Hamburg (West Germany)). Mar 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

For large-statistics bubble chamber experiments it is important to have a very effective control of the data-taking and evaluation system with regard to measuring precision as well as data handling. Difficulties in both areas may have consequences for the loss of events or for other distortions of the results. Under these aspects an HPD-based analysis chain is described and the performance of the chain and the quality of the measurements are discussed. (auth)

2735 (IFVE-SVM-71-35) RECONSTRUCTION OF PARTICLE TRAJECTORIES WITH ACCOUNT OF MULTIPLE SCATTERING BY "BROKEN LINES." Zhigunov, V. P.; Zhigunova, I. A.; Nikitin, S. G.; Perelygin, V. F.; Sokolov, S. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 33p. (In Russian). INIS.

The derivation of the functional for the calculation of the parameters of particles moving in the liquid of a bubble chamber was reported. The functional is based on the introduction of all random parameters which determine the significance of the results of the measurement of the coordinates of points on the projection. This makes it possible with maximum precision to take into account multiple scattering and to facilitate the analysis of events of the single or nuclear scattering type. The basic diagram of the program for the reconstruction of the trajectory of particles by the broken line method is described. Some specific numerical algorithms are given. The results of the statistical analysis of the program are reported. (tr-auth)

2736 (ORO–2504-202) WIDE-GAP SPARK CHAMBER SYSTEM FOR NAL EXPERIMENT 2-B. Technical Report No. 73-091. Svrcek, F.; Zorn, G. (eds.) (Maryland Univ., College Park. Dept. of Physics and Astronomy). Feb 1973. 56p. Dep. NTIS $5.00.

The bubble chamber–spark chamber hybrid system currently in operation for NAL experiment 2-B is described. The wide-gap spark chambers are discussed primarily. Topics include the physical arrangement; spark chamber enclosure and contents; counters and fast logic used in triggering system; slow logic to control the high-voltage switches, data box, fiducials, and cameras; monitors available for the system; and gas systems including the spark chamber gas system and the nitrogen gas system for the Marx generators. (WHK)

2737 (ORO-2504-204) PREAMPLIFIER FOR MULTI-WIRE PROPORTIONAL COUNTERS. Technical Report No. 73-097. Trasatti, L.; Zorn, G. T. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Mar 1973. 13p. Dep. NTIS $3.00.

The characteristics of 54 small 14-channel preamplifiers for use with multi-wire proportional-counter detectors (MWPC) are described. These detectors will be used at Adone, the e^+e^- colliding beam accelerator located at Frascati (Italy), inside the experimental magnet detector (MEA) which is to surround one of the e^+e^- interaction regions. Severe space limitations forced the placement of all logic circuits outside the magnet and restricted the size and physical configuration of these preamplifiers. (auth)

2738 BIG BUBBLE CHAMBER MIRABELLE. Berthelot, A. (CEN de Saclay, Gif-sur-Yvette, France). Develop. Ind. Sci.; No. 7, 8-11(Nov 1971). (In French).

The Mirabelle bubble chamber is presented. The different stages of its construction and the first experiments performed are reviewed. (FR)

2739 EXPERIMENTAL STUDY OF PHOTON-INITIATED SHOWERS IN LEAD BETWEEN 150 AND 450 MeV. Sober, D. I.; Haddock, R. P.; Nefkens, B. M. K.; Schrock, B. L. (Univ. of California, Los Angeles). Nucl. Instrum. Methods; 109: No. 1, 29-39(1973).

The development of photon-initiated showers of primary energy between 150 and 450 MeV was studied in a 10-radiation-length lead-plate spark chamber system. The charged particle detection probability as a function of depth in the radiator is presented and compared with published Monte Carlo calculations. A comparison with simultaneous scintillation counter measurements is also presented. (auth)

2740 DETAILED DESCRIPTION OF A VERY HIGH VOLTAGE FAST PULSE GENERATOR. Gissinger, G.; Jacquey, S.; Binder, G.; Schmitt, F. M.; Sutter, G. (CRN, Strasbourg). Nucl. Instrum. Methods; 109: No. 1, 157-170(1973). (In French).

A detailed description of a very high voltage pulse generator for use with a streamer chamber is given. The properties and the equivalent circuits of the generator are analyzed and the output pulse is calculated. The generator yields: output amplitude up to 600 kV, pulse width variable between 5 and 20 ns, delay less than 100 ns, and negligible jitter. (auth)

2741 BLOCKS OF ELECTRONIC PHYSICS EQUIPMENT FOR OPERATION AT LOADINGS OF UP TO 100 MHz. Kuzichev, V. F.; Rabin, N. V.; Tyapkina, G. N.; Yablonin, K. I. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1361-1365(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 66-70(1972).

Blocks of electronic physics equipment are described: a shaper, an integrating discriminator, AND-NOT, AND-OR-NOT logic elements, and the power-supply block for the last dynodes of the photomultipliers. The equipment is designed for handling time and amplitude information from scintillation and Cherenkov counters for loadings of up to 100 MHz. (auth)

2742 DETECTOR OF TRANSITIONAL X-RADIATION FROM HIGH ENERGY PARTICLES. Alikhanyan, A. I.; Ispiryan, K. A.; Kankanyan, S. A.; Oganesyan, A. G.; Tamanyan, A. G. (Inst. of Physics, Erevan). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1343-1345(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 51-52(1972).

The construction of a detector of x-ray transition radiation is described, and the results of an experimental investigation of the detector are presented. The efficiency with which electrons having energies of 1.7 to 3.6 GeV are recorded is compared with the results of a calculation performed by the Monte Carlo method. (auth)

2743 MOVING SCREEN IN FRONT OF THE MEMBRANE OF THE EXPANSION SYSTEM IN A BUBBLE CHAMBER. Borisov, V. N.; Golubchikov, V. M.; Dolgolenko, A. G.; Konoplev, N. S.; Shebanov, V. A. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1326-1327(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 36-37(1972).

The construction and principle of operation of a moving screen mounted in front of the membrane expansion system in a 180-liter xenon bubble chamber at the Institute of Theoretical and Experimental Physics are described. Using the screen, it was possible to improve the quality of the photographs substantially. (auth)

2744 THREE-ELECTRODE BLUEMLEIN LINE FOR SUPPLYING A STREAMER CHAMBER. Chirochkin, V. S.; Shaulov, S. B. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1328-1330(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 38-40(1972).

The construction of a Bluemlein line and a shaping spark gap is described which produce pulses having an amplitude of 260 kV and a length of 13 nsec. (auth)

2745 INSTALLATION FOR INVESTIGATING RADIATIVE DECAYS OF RESONANCES. Astvasaturov, R. G.; Baldin, A. M.; Basiladze, S. G.; Volodin, V. D.; Ivanov, V. I.; Kramarenko, V. A.; Kolpakov, I. F.; Matyushin, A. T.; Matyushin, V. T.; Melkumov, G. L.; Smirnov, V. A.; Khachaturyan, M. N.; Khvastunov, M. S. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1307-1311(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 21-25(1972).

A two-channel Cherenkov mass spectrometer which operates into a line with an electronic computer for studying the decay of resonance particles is described. The detectors are considered as well as the electronic equipment and the method for calibrating and monitoring the principal parameters. The characteristics of the installation are presented. (auth)

2746 ISOLATION OF ELECTRONS IN BEAMS OF SECONDARY PARTICLES HAVING A MOMENTUM OF UP TO 50 GeV/c AND THE RECORDING OF ELECTRON SHOWERS. Kachanov, V. A.; Kut'in, V. M.; Lapshin, V. G.; Rykalin, V. I.; Semenov, V. K. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1312-1315(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 25-28(1972).

The utilization of high-resolution Cherenkov threshold counters for isolating electrons in beams of secondary particles is described. Data are presented on the yields of electrons and the results of certain systematic investigations using electron beams. The results of measuring the energy resolution of lead-scintillation sandwiches in the electron-energy range up to 50 GeV/c and measuring the dimensions of electromagnetic showers by means of a scintillation hodoscope based on a hodoscopic photomultiplier are presented. (auth)

Radiometric Instruments

Refer also to abstract 2093.

2747 (ITJ-28) SOIL DENSITY MEASURING BY $\gamma-\gamma$ METHOD RANGE 0.5 TO 1.4 g/cm^3. Moscicki, J. (Institute of Nuclear Research, Krakow (Poland)). 1972. 33p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.75.

The use of the $\gamma-\gamma$ method for measuring soil densities in the interval 0.6 to 1.4 g/cm^3 for peats and silts is discussed. That is in the range of densities where, for the most of $\gamma-\gamma$ probes, the maximum of the calibration curve is observed and for this reason a simple single-counter probe cannot be used. It has been shown that using a two-counter probe with the counters placed in such a way that for the one nearer to the source the slope of the calibration curve is positive and for the one farther away it is negative, a good sensitivity of measurement can be achieved. Several possibilities of an interpretation method for density measurement with the two-counter probe have been proposed, i.e., probes using two independent calibration curves, probes using the difference of the count rates, and probes using the ratio of the count rates. The method using the count rate ratio has proved to be the best one as it needs no standardization measurements. It allows the elimination, at least partially, of the influence of the chemical composition of the medium and that of the adjacent layer on the measurement results. The method shows a good sensitivity. Different γ-ray sources have been tested as for their applicability to the method described above and a ^{137}Cs source has been finally adopted. (auth)

2748 DENSITY MEASURED WITH ISOTOPES. Ennever, B. Contr. Instrum.; 5: No. 4, 62-63(Apr 1973).

Measuring systems using radioactive isotopes permit the continuous exact measurement of density, thickness, and level in a system in which the material being measured is neither affected, obstructed nor contacted. This method can provide precise quality control without stopping the manufacturing process for random sample taking. Radioactive-isotope systems are ideal where contaminated or corrosive liquids are being handled and they can also be applied to solid substances, powders or grain or even solid materials. From density measurements, concentration, dry-substance, and solid-substance contents and a degree of saturation can often be determined, and in special circumstances the percentage of one component in a multicomponent mixture can be measured. (auth)

2749 RADIOMETRIC HUMIDITY MEASUREMENT AND A NEW CALIBRATION METHOD. Grieser, F.; Klein, R. Stahl Eisen; 92: No. 26, 1332-1335(1972). (In German).

A new method for the calibration of neutron moisture gages for blast furnace cokes is described. By means of this method an increase in automation and an improvement of reliability and accuracy is obtained. Measurements for bulk materials with respect to dry weight can be made. (GF)

2750 MEASURING SOIL MOISTURE NEAR THE SURFACE WITH THE NEUTRON SUBSURFACE PROBE. Sharma, M. J.; Tunny, J. (Commonwealth Scientific and Industrial Research Organization, Canberra, Australia). J. Aust. Inst. Agr. Sci.; 38: No. 3, 221-223(Sep 1972).

An improved technique for measuring soil moisture near the surface with the neutron subsurface probe was developed, so that only one calibration curve can be used for all depths. The use of a cadmium sheet in combination with a polyethylene hydrogenous shield at the surface enabled reliable soil moisture measurements at depths below 5 to 10 cm of the surface, without affecting the overall sensitivity of the probe. The technique is safe as it does not require exposure and handling of radioactive source. (auth)

2751 AUTOMATIC RECORDING OF THE MOISTURE DENSITY AND THE WATER CONTENT VARIATION IN SOIL BY MEANS OF γ-RAYS. Lorch, S. (Niedersaechsisches Landesamt fuer Bodenforschung, Hanover). Z. Pflanzenernaehr. Bodenk.; 130: No. 2, 136-151(1971). (In German).

A method is described with which the moisture, density, and changes of the water content can be measured automatically. A

collimated γ-ray (^{137}Cs) is measured according to the absorption principle. Two tubes are inserted into the soil as parallel as possible, about 50 cm apart. One tube contains a γ source, the other a detector moved up and down simultaneously. The density and the changing of the water content are calculated from the measured counting rate. The measuring time for each step is variable, but usually about 5 to 10 min. The distance in depth between the measuring stations can also be varied. The accuracy of the instrument in field use amounts to: water content variation ±0.0015 g/cm^3; soil density: ±0.003 g/cm^3. The resolution is such that horizontal layers of about 10 mm thickness can be distinguished in respect to the water content. (GF)

2752 ESTIMATION OF THE THERMODYNAMIC CONDITION EFFECT ON THE RESULTS OF THE WATER-BEARING COLLECTOR: STUDY BY THE NEUTRON–NEUTRON METHOD ON THE BASIS OF ABOVE-THERMAL NEUTRONS. Kozachok, I. A.; Riznik, Ya. M. O. (Inst. of Geophysics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 3, 230-233(Mar 1973). (In Ukrainian).

Relative changes in the moderation length and density of thermal neutrons from the point source in the infinite homogeneous medium (water-bearing quartz sand rock with porosity from 1 to 40% and fresh water) were studied depending on the seam pressures and temperatures corresponding to the depths of the rock up to 15 km. The analysis of the obtained data permits the neutron–neutron method on the basis of thermal neutrons to be considered a rather promising one for estimating the porosity of the water-bearing collectors in deep bore-holes. (auth)

2753 MEASUREMENT OF MOISTURE CONTENT OF CONCRETE. Andreae, G. (Bundesanstalt fuer Materialpruefung, Berlin). Materialpruefung; 15: No. 3, 95-97(1973) (In German).

As far as the ordering of the processes used for the correct measurement of the total content of physically bound water in concrete is concerned, direct methods (measurements on the original concrete) are better than indirect methods which have great disadvantages. The primary measuring effects (e.g., measuring the dielectric number) in particular limited primary methods (thermal conductivity, neutron probes) are generally more advantageous than the secondary ones (electric conductivity). For a given intensity of the primary fast neutrons, the intensity of thermal neutrons is a relative measure for the moisture content in the concrete samples. (GF)

2754 THEORY AND PRACTICE OF NUCLEAR WIRE THICKNESS GAGING. Plesch, R. Messtechnik; 80: No. 10, 284-290 (1972). (In German).

The method of nuclear wire thickness gaging is briefly described and its sensitivity and accuracy defined. The general theory to find out these two criteria of the measuring method is pointed out. A numerical comparison with measurements on steel and structural steel wires gave satisfactory agreement between theory and practice. The measuring equipment improves the deviation of the final product considerably. (GF)

2755 MONTE-CARLO CALCULATIONS FOR THE SUBSURFACE γ DENSITY GAUGE. Christensen, E. R. (Technical Univ., Lyngby, Denmark). Nucl. Eng. Des.; 24: No. 3, 431-439(1973).

Some characteristics of the subsurface gamma density gages are investigated by means of a Monte Carlo model. The model, which is one-dimensional and spherical, accounts for the effect of the shielding between source and detector in a simplified manner. The influence of Z_{eq}, Z/A and a finite volume of the measured medium on the gage response is studied attentively. For densities above 1 g/cm^3, the radius of the sphere of importance is about 26 to 40 cm and considerably larger at lower densities. Attention is further paid to the dual-gage concept with two different source-detector distances. Important advantages of this concept are diminished influence of Z_{eq} and somewhat increased density measuring range, whereas longer counting times and a more complicated gage configuration seem to be the main drawbacks. Good agreement between the calculations and measurements with the BASC gage is obtained, if maximally two experimentally determined parameters are introduced. (auth)

2756 MONTE-CARLO SIMULATION OF γ-RAY BACKSCATTER SOIL DENSITY GAUGES. Hopkins, W. C.; Gardner, R. P. (North Carolina State Univ., Raleigh). Nucl. Eng. Des.; 24: No. 3, 332-343(1973).

The Monte-Carlo code OGRE-G is modified to calculate spectral and spatial distribution of the z-component of the backscattered γ-ray current. Calculational procedures are developed and demonstrated for translating this current into the response of the most common types of γ-ray soil density gages. Results were obtained for average soil, chalk, aluminum, and magnesium. The source considered was ^{137}Cs, and six photon energies and 10 spatial distances were considered. Parameters are given for an empirical model determined by a linear regression analysis of all the predicted current results. The explicit dependence of the model on density could be specified by a technique involving translating the differential current to cumulative current and then reversing this process. The results and procedures developed in this study should prove useful for the calibration of γ-ray soil density gages by determining the model constants from experimental responses on chalk, aluminum, and magnesium. The results should also prove useful in the optimum design of these gages. (auth)

2757 LEVEL GAGE MEASURING TECHNIQUE. Schlepuetz, H. Glueckauf; 109: No. 6, 340-346(1973). (In German).

Level gages are used on mining sites for economical and automation reasons, particularly in separating plants. A short survey of the measuring systems employed to indicate the limit values is given and to continually show conductivity measurements, capacity measurements, isotope measuring equipment, γ-relays, microwave relays (radar), and electromechanical probing systems. (GF)

2758 DEVICE FOR AUTOMATIC CALCULATION FOR THE RESULTS OF RELATIVE RADIOMETRIC MEASUREMENTS WITH BACKGROUND RADIATION SUBTRACTED. Malakhov, A. V.; Suetnov, O. N. Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 144-153(1972). (In Russian).

A specialized arithmetic device and its operating principle for performance of relative difference measurements using a two-channel radiometric apparatus are described. The device allows compensation of the background with constant spectral distribution and variable intensity with high accuracy and calculation of the result of the analysis. The parameters of the device developed are defended and its block diagram and diagrams of individual units are presented. A report is presented on the experimental checking of difference measurements using the device described. (JPRS)

2759 MEASURING PROCEDURE WITH RADIOISOTOPES OF PACKAGING FOILS. Reinsch, H. H. Neue Verpack.; 25: No. 10, 1342; 1345(Oct 1972). (In German).

By means of radioactive isotopes, a new measuring procedure was developed for packaging foils of plastics and paper during their coating and printing. The procedure increased accuracy, line velocity, and quality, while it reduced simultaneously the number of rejects. The procedure permitted semi- as well as full-automated coating and printing. Thus, significant improvements occurred in rationalization, production, and quality control. In principle, the new procedure was based on the area-related mass, i.e., on measurement of areal weight. (tr-auth)

2760 LEVEL GAGING AND CONTROL BY MEANS OF RADIOISOTOPES. Schlepuetz, H. (Endress und Hauser G.m.b.H. und Co., Maulburg, Ger.). Haus Tech., Essen, Vertragsveroeff.; No. 301, 27-39(1972). (In German).

The principle, arrangement, measurement techniques, and radiation protection of γ-relays (^{60}Co, ^{137}Cs, ^{241}Am) are briefly described and some industrial applications (e.g., concrete bunker chemical reactor and refuse incinerator) are discussed. (GF)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

2761 (N–73-11044) DEVELOPMENT OF LITHIUM-DOPED RADIATION RESISTANT SOLAR CELLS. Berman, P. A. (Jet Propulsion Lab., Pasadena, CA). 15 Nov 1972. Contract NAS7-100. 25p. (NASA-CR–129183; JPL-TR-32-1574). NTIS.

Lithium-doped solar cells have been fabricated with initial lot efficiencies averaging 11.9 percent in an air mass zero (AMO) solar simulator and a maximum observed efficiency of 12.8 percent. The best lithium-doped solar cells are approximately 15 percent higher in maximum power than state-of-the-art n-p cells after moderate to high fluences of 1-MeV electrons and after 6 to 7 months exposure to low flux irradiation by a Sr-90 beta source, which approximates the electron spectrum and flux associated with near Earth space. Furthermore, lithium-doped cells were found to degrade at a rate only one-tenth that of state-of-the-art n-p cells under 28-MeV electron irradiation. Excellent progress has been made in quantitative predictions of post-irradiation current-voltage characteristics as a function of cell design by means of capacitance-voltage measurements, and this information has been used to achieve further improvements in lithium-doped cell design. (auth)

2762 (ORNL-4842) DEVELOPMENT OF RADIATION-RESISTANT INSULATORS. Final Project Report, July 1, 1966 to January 15, 1972. Parkinson, W. W.; Kelly, M. J. (Oak Ridge

National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 107p. Dep. NTIS $3.00.

For Army Electronics Command, Fort Monmouth, N. J. and Defense Civil Preparedness Agency, Washington, D. C.

The electrical properties of capacitor insulation (the critical component in ion-chamber, quartz-fiber, dosimeters) were related to theories of conduction and dielectric relaxation in insulators. A general survey revealed that a $K_2S_2O_8$-initiated, emulsion-polymerized copolymer of styrene and α-methyl styrene had a uniquely rapid decay of conductivity following irradiation. This decay of conductivity resulted from removal of mobile charge carriers (identified as electrons or "holes") by a polar phase uniformly dispersed through the polymer by association with sulfate chain ends. A recipe for polymerization of a styrene homopolymer having such trapping species was optimized for moisture sensitivity and fabrication characteristics. Rapid decay was also achieved by incorporation of organic phosphites in solution-cast plastic films. It was found that acid groups (methacrylic, maleic) copolymerized with styrene were without effect on postirradiation conductivity. Effective trapping was produced, however, by neutralization and incorporation of water or emulsifier. This demonstrated that trapping action was not associated with a unique chemical composition but with a strongly polar phase uniformly distributed through the polymer. (auth)

2763 (SLA-73-462) STUDY OF THE COMBINED EFFECTS OF IONIZATION, NEUTRONS, TEMPERATURE, AND TIME ON BIPOLAR DEVICES. Shafter, B. D.; Habing, D. H.; Horning, L. K. (Sandia Labs., Albuquerque, N. Mex.). Apr 1973. 99p. Dep. NTIS $7.00.

A detailed study was made of the combined effects of neutrons, gamma-rays, temperature and time on the gain of three bipolar transistor types. The main objective of the study was to determine a method by which the combined effects of such environments could be established and if it was sufficient to consider each of the environments independent of each other. (auth)

2764 SILICON SURFACE BARRIER DETECTORS IRRADIATED BY 500 keV-1 MeV ELECTRONS. Nakamoto, S. (Chubu Inst. of Tech., Aichi, Japan); Aoki, T.; Kawabata, K. Mem. Chubu Inst. Technol.; 7: 127-135(Dec 1971).

The radiation effects on silicon surface barrier detectors by 500 keV, 750 keV, and 1 MeV electrons have been investigated using fifty in-house fabricated detectors of 200 to 1000 Ωcm resistivities. The change of reverse current, forward current, depletion layer capacitance, and ^{210}Po α spectrum were measured. The reverse current changes in complicated forms with electron fluence. The forward current and the capacitance begin to change at 1×10^{15} cm^{-2} and the capacitance tends to saturate at 5×10^{16} cm^{-2}. The α spectrum begins to degrade at 1×10^{14} cm^{-2} and the double peaks are observed at higher fluences. The detector characteristics are dependent on the total electron dosage, incident electron energy, and detector thickness. These effects mean the formation of trap centers is quite significant in the irradiated silicon. (auth)

2765 EFFECTS OF HEAVY-PARTICLE EXTERNAL IONIZATION SOURCE ON CARBON DIOXIDE LASER DISCHARGES. Ganley, J. T. Urbana, IL; Univ. of Illinois (1972). 80p. University Microfilms Order No. 73-9937.

Thesis (Ph. D.).

High energy nuclear particles produced by the reaction of thermal neutrons with boron-10 served as an ionization source which was completely independent of any applied electric fields. The presence of the external ionization decoupled the electron production process from the electron heating process. The result was a pronounced change in the electrical characteristics of the discharge. In low pressure (<50 torr), longitudinal discharges, the external ionization has made it possible to control the discharge current and E/N independently. Conditions have thus been produced which are more favorable for laser operation than the conditions which can be produced with only an applied electric field. Under these conditions, increased laser output and efficiency have been obtained. Increases in laser power output and efficiency have also been obtained from irradiated high pressure (100 to 760 torr) transverse discharges. Also, for any given pressure, there is a decrease in the voltage required to produce breakdown and lasing. Correspondingly, for a given value of voltage, there is an increase in the maximum pressure at which lasing can be achieved. The collision frequency for excitation of the upper laser level has been measured on a per electron basis as a function of E/N. For the particular gas mix involved, the peak in the curve corresponds to the electrical operating conditions which produce the most efficient laser pumping. In addition to changing the electrical characteristics of the discharge, the external ionization also appears to have a pronounced effect on the shape of the electron energy distribution function. It is believed that this phenomenon is important in affecting laser performance. The results of experiments with electrostatic probes imply that the external ionization produced important changes in the high energy tail of the electron distribution function. (Diss. Abstr. Int., B)

Miscellaneous Instruments

Refer also to abstracts 2500, 2501, 2519, 2530, 3123, 4062, and 4637.

2766 (EUR-4896(Vol.1), pp 511-528) CALCULATION OF A NEUTRON COLLIMATOR FOR THERAPEUTIC PURPOSE. Gruenauer, F. (Gesellschaft fuer Strahlen-und Umweltforschung m.b.H., Neuherberg, Ger.). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

In order to produce narrow neutron beams for therapeutical purposes, collimators have to be applied. The quality of a collimator can best be characterized by the deviation of the isodose curves in the body produced by a practical neutron beam from those which could be obtained by an ideal, geometrically limited, narrow beam. The data for both cases are calculated for an idealized homogeneous cylindrical phantom, using the SN-transport code DOT. Only the neutron component of the total dose was considered. Calculations were performed mainly for 15 MeV neutrons. Also some preliminary results are given for D,D-neutrons from a gaseous source at a compact cyclotron. The influence of the duct-scattered neutrons on the dose outside the direct beam region compared with that of the body-scattered neutrons is shown to be considerable. Aspects of improvements in this regard are discussed. (auth)

2767 (EUR-4896(Vol.1), pp 529-539) OPTIMIZATION OF A COLLIMATOR FOR 14-MeV NEUTRONS. Hehn, G.; Becker, R. (Univ., Stuttgart). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The economic way of dealing with such optimization problems is first of all to let the computer make a selection of the collimator materials as well as the geometrical configuration of the collimator and then secondly to verify the best results by experiment. The first part was done with the following results: the best form of the collimator duct is given by considerations according to geometrical optics. Every additional broadening of the duct near the source or near the end of the collimator gave results which were not good. For selection of collimator materials, materials containing hydrogen-like polyethylene were used, but it was found quickly that iron gives by far a better beam profile. The best material for neutron collimation is tungsten. Tungsten does not change the beam profile of iron in the central parts but it has a minimum of scattered neutrons on the sides and has a lower activation, which is important for the application of the collimator. A proposal for a practical collimator structure consists of a tungsten layer along the duct, followed by a large iron cylinder and surrounded radially by a neutron shield of borated polyethylene with a thin lead layer against secondary gamma-rays. (auth)

2768 (EUR-4896(Vol.1), pp 541-557) DEVELOPMENT OF A 15-MeV NEUTRON BEAM COLLIMATOR FOR RADIOTHERAPY. Knight, A. (National Radiological Protection Board, Sutton, Eng.); Lundberg, D. A.; Marshall, T. O. Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Fast neutron beams for therapy cannot readily be defined by a system of adjustable opaque vanes as in the case of x-rays. Consequently, for clinical neutron therapy a system of interchangeable apertures or collimators must be used to define and adjust the size and shape of the neutron beam. Such collimators must be designed so as to reduce the dose to the patient in all regions outside the treatment field to an acceptable level. Other design constraints are the maximum level of induced radioactivity which will allow safe and convenient handling of the collimators, the maximum collimator length and finally, of course, the cost. The design and performance of the collimator used in the Elliott neutron therapy equipment, the "Hiletron". This collimator, which is of total length 60 cm, has a performance comparable with that of a steel/polyethylene collimator 50 cm long but its induced radioactivity is considerably reduced. Penumbra dose curves and induced activity levels have been measured in an experimental rig simulating the "Hiletron". In the design to be adopted in the prototype unit the dose rate is reduced to 10%, 5%, and 1% of that in the treatment beam at distances outside the treatment area of 1.5, 4, and 18 cm respectively, for a field size of 10 cm × 10 cm at 75 cm SSD. (auth)

2769 (EUR-4896(Vol.1), pp 559-579) RARE EARTHS AND NEUTRON COLLIMATION. Genty, P. (Foundation Curie, Paris). Sep 1972. (In French).

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

An important factor in research on every neutron therapy problem is the development of the appropriate collimator. Upon this depends the ability to treat a sick person with the most even dose distribution possible, and the case of operation of the assembly by the staff responsible for handling it. After comparing various materials, it was decided to try lanthanides. Preliminary studies were made with a neutron generator tube using the T(d,n) reaction. The first results are encouraging from both the absorption and the activation standpoint. Another series of irradiations has been carried out on much larger samples. (auth)

2770 (KFK-1752) CAMAC PULSE GENERATOR LEM-52/13.1. Dietzel, G.; Fischer, P. M. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Feb 1973. 25p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

A computer-controlled pulse generator in CAMAC consisting of an ORTEC Model 448 pulse generator and a control unit is described. The parameters for the pulse height control are computer controlled. The pulse height control is a precision Kelvin-Varley voltage divider containing three decade switches, decade I, decade II, and decade III and a slidewire interpolating potentiometer called a fine divider. The parameters decade I, decade II, and decade III are varied by direct-current motors and the fine divider parameter is varied by a stepping motor. (GF)

2771 AUTOMATIC APPARATUS USING NEUTRON TECHNIQUES TO MEASURE SOIL HUMIDITY. Couchat, P. (CEN de Cadarache, Saint-Paul-les-Durance, France); Palumbo, C.; Volat, J. P.; Legrand, B. Bull. Inform. Sci. Tech. (Paris); No. 172, 71-76(Jul 1972). (In French).

An apparatus already available in the industrial form is presented. It is used for the measurement and automatic recording of soil moisture and uses neutron techniques. The operation of the apparatus can be completely programmed. The parameters of the water content measurement obtained are recorded on a minicassette in view of a manual or computerized processing at a later date. This moisture gage could have applications in agronomy, civil engineering, and industry. (FR)

2772 GLOVE BOX ASSEMBLY FOR PERKIN-ELMER 237 INFRARED SPECTROPHOTOMETER. Subramanian, M. S.; Srinivasan, P. S.; Mithapara, P. D. (Bhabha Atomic Research Centre, Bombay). J. Phys., E (London); 6: No. 5, 431-432(May 1973).

A simple and inexpensive attachment to a glove box for recording the infrared spectra of radioactive samples with a Perkin-Elmer 237 infrared spectrophotometer is described. The use of this assembly does not contaminate the spectrophotometer thereby avoiding the difficulties encountered in servicing the instrument. (auth)

2773 SPUTTERING MASS SPECTROMETER WITH CESIUM PRIMARY ION SOURCE. Ueda, Y.; Okano, J. (Osaka Univ., Toyonaka, Japan). Shitsuryo Bunseki; 20: No. 3, 185-195(Sep 1972).

A sputtering mass spectrometer with a cesium primary ion source was constructed. Two types of the surface ionization ion source for producing the cesium ion beam were made and their characteristics were studied. The second type of the source, which had two filaments in the ionization chamber proved to have superior performance. The beam current of $0.5 \sim 2.0 \times 10^{-7}$A was obtained for more than 50 h. The diameter of the beam on the surface of the target was about 0.45 mm. By using cesium ions as the primaries, the charge up effect due to the ion bombardment of insulating materials was much reduced, and the stability of the secondary ion current was enough for accurate analysis. Results of the preliminary measurements for the isotopic abundance ratio of lithium in the potassium alum crystal were described. The possibility of the high sensitive analysis of negative secondary ions is discussed. (auth)

2774 RELIABILITY OF MEASUREMENT AND CONTROL DEVICES. Sheet 1. Failure Data Acquisition. Brennst.-Waerme Kraft; 25: No. 3, 89-92(1973). (In German).

The VDE/VDI specialist groups in measuring and control techniques also deal with the reliability of equipment. They have set up a catalogue as a preliminary guideline in the comprehension of reliability data which is also relevant in the nuclear industry. (GF)

2775 LINE SHAPES OF DOPPLER SHIFTED γ-RAYS FROM COINCIDENCE AND SINGLES SPECTRA IN MEASUREMENTS OF NUCLEAR LIFETIMES. Hoffman, E. J. (Bartol Research Foundation, Swarthmore, PA); Van Patter, D. M.; Sarantites, D. G.; Barker, J. H. Nucl. Instrum. Methods; 109: No. 1, 3-11(1973).

A procedure is described for extracting nuclear lifetimes from the analysis of line shapes of γ-rays from either coincidence or singles spectra obtained from Doppler-shift attenuation experiments. The nuclear and electronic stopping powers in a given slowing down medium are independently adjusted to give the line shape and lifetimes of "standard" Doppler-shifted γ-rays, the lifetimes of which have been determined by other independent methods. The stopping power thus calibrated is then used to determine the lifetimes of other transitions from Doppler-shift attenuation experiments in the same stopping medium. Line shapes are obtained by including the effects (a) of the recoils that escape the target, (b) of the decay of other levels into the state in question, (c) of the γ- or particle-detection angles and their corresponding solid angles, (d) of the integration over the distribution of recoils in the singles experiments including angular correlation effects to a good approximation for angles of observation ≤30° to the beam direction, and (e) of the detector response assumed to be gaussian. Lifetimes are obtained from comparison with experiment using both a line shape fitting technique and the F(τ) or centroid-shift technique. (auth)

2776 NEW APPROACH TO THE ANALYSIS OF THE DOPPLER SHIFT ATTENUATION MEASUREMENTS. Kregar, M.; Kump, P.; Pavsic, M.; Vakselj, M. (Univ., Ljubljana, Yugoslavia). Nucl. Instrum. Methods; 109: No. 1, 109-117(1973).

When lifetimes of nuclear excited states are evaluated, using γ-ray Doppler shift attenuation measurements, a continuous stopping process of the excited nucleus in the target material is assumed. This assumption is usually well justified when the ion velocities are greater than 0.002 c because in such cases electron stopping dominates over atomic stopping. But when ion velocities are less than 0.002 c the collisions of the moving ion with the target atoms become dominant. Such is the case, for instance in (p,γ) reactions on the light or medium heavy nuclei, at low bombarding energies. Here the moving ion will be effectively stopped by very few collisions with the target atoms. In this paper the shape and the centroid shift of the Doppler shifted emission line is calculated using only the first few ion-atom collisions. Results are compared with those obtained in the usual way, where the average stopping power is used. (auth)

2777 UNIVERSAL DIGITAL ROUTING UNIT. Uyttenhove, J.; Demuynck, J. (Rijksuniversiteit, Ghent). Nucl. Instrum. Methods; 109: No. 1, 195-198(1973).

A digital apparatus for the investigation of isomeric states is described. Nuclear spectra are registered in 16 consecutive time intervals. The system has an excellent time resolution over a wide range of measuring intervals, selected digitally. The lower limit is 5 μs, the precision better than 10 ns. The unit is built with low cost standard TTL IC's and is compatible with most computers and multichannel analyzers. (auth)

2778 BCD ADDITION AND SUBTRACTION WITH BINARY ADDERS. May, F.; Marschik, W. (Institut fuer Elektronik, Seibersdorf, Austria). Nucl. Instrum. Methods; 109: No. 1, 199-201(1973). (In German).

The production of BCD adders and subtractors has been announced by different manufacturers several times. As this is not verified up to now, a simplified circuit is described which allows the addition and subtraction of binary coded decimal numbers by using 4 bit binary adders. The same circuit can be used for addition and subtraction if in the first case the number 6 is added and in the second case the subtractor is complemented. (auth)

2779 TECHNIQUES FOR POLARIZATION TRANSFER COEFFICIENT DETERMINATION. Salzman, G. C.; Mitchell, C. K.; Ohlsen, G. G. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 109: No. 1, 61-76(1973).

It is shown how polarization transfer coefficients in reactions with the spin structures $\frac{1}{2} + A \rightarrow \vec{I} + B$, $\vec{I} + A \rightarrow \vec{I} + B$ and $\vec{I} + A \rightarrow \frac{1}{2} + B$ can be determined by ratio techniques in which detector efficiencies, solid angles, and relative counting interval are cancelled out. The relative merits of using a "polarized-to-unpolarized" ratio method to a "spin-up-to-spin-down" ratio method are discussed. (auth)

2780 TECHNIQUES FOR MEASUREMENT OF SPIN-½ AND SPIN-1 POLARIZATION ANALYZING TENSORS. Ohlsen, G. G.; Keaton, P. W. Jr. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 109: No. 1, 41-59(1973).

Techniques for measurement of spin-½ and spin-1 analyzing tensors with a view to the control or elimination of first-order systematic errors which may arise from misalignments of various types are discussed. The concept of a "proper flip" and a "nonproper flip" is introduced for both spin ½ and spin 1. Sev-

eral methods for measurement of spin-1 analyzing tensors are described and their relative merits are evaluated. (auth)

2781 CORROSION RATE APPARATUS (17 FEB 1970) (ENGINEERING MATERIALS). (California Univ., Livermore. Lawrence Livermore Lab.). (CAP-2338).

13 Drawings.

A thermogravimetric system that is capable of holding six specimens suspended in a flowing test gas at constant temperature (±0.1°C) and constant dew point (±1°C) is described. The temperature and humidity of the test gas can be varied independently of each other: gas temperatures from ambient to 200°C and humidities from 30 to 500 torr of water vapor. Each specimen can be weighed individually at any time without removal from the test environment. All-metal components and seals have reduced the inboard leakage of oxygen to the point where the system can be operated at the oxygen level in the carrier gas (<4 ppM). The system has been extensively used to study the oxidation of thorium in humid air and humid nitrogen. Statistical methods were used to evaluate the accuracy of results obtained with this system. (auth)

2782 SHIM-MOUNTED HIGH-TEMPERATURE STRAIN GAGE. Egawa, K. (National Aerospace Lab., Chofu, Japan). Hihakai Kensa; 21: No. 12, 740-751(Dec 1972). (In Japanese).

For obtaining more accurate thermal strain measured with strain gage, a self-temperature compensated strain gage is mounted on a shim which is a little wider and longer than the gage, then the gage is welded on a test coupon for measuring the apparent strain and the gage-factor shift. The gage is cut out just behind the welding lines from the coupon by an adequate tool like the diamond cutter, then, the gage is welded again at the measuring point of the test structure, by using the left part of the shim of the gage. In accordance with this suggestion, the thermal strains of a long, hollow cylinder subjected to uniform inner heating are measured, and accurate thermal strains are obtained. Thus, the test results verify the excellency of this method of thermal strain measurement. The method, as applied to multi-points thermal strain measurement, can reduce the cost of experiment. (auth)

2783 SECONDARY-ION MASS SPECTROMETER WITH ELECTRIC QUADRUPOLES OF HIGH DETECTION SENSITIVITY. Maul, J.; Schulz, F.; Wittmaack, K. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 9p. (In German).

From 1972 spring meeting of the German Physiology Society; Regensburg, Germany (5 Apr 1972).

A mass spectrometer is described which is suitable for the determination of doping profiles in semiconductor materials. It allows to detect quantitatively impurity atoms in a matrix at concentrations in the ppb range with a depth resolution of 50 A. (INIS)

2784 SIMPLE ION GUN. Bakker, J. M. B. (Shell Research Ltd., Sittingbourne, Eng.). J. Phys., E (London); 6: No. 5, 457-458(May 1973).

A simple electron bombardment ion gun based on a Mullard cathode-ray tube and a Nier type ionization chamber is described. The ion source has a sensitivity of 60 μA Torr^{-1} for air, and produces ion beams up to 0.1 μA. Focal length is variable from 20 to 200 cm with a beam diameter of about 2 mm. The gun has been used successfully in a number of time-of-flight mass spectrometers. (auth)

2785 CHOPPER WITH PSEUDOSTATISTICAL SLOTS FOR THERMAL NEUTRON SPECTRA MEASUREMENTS. Graffstein, A. (Inst. of Nuclear Research, Warsaw). Nukleonika; 18: No. 1, 45-56(1973). (In Polish).

A new formulation of the problem of codes used for correlation choppers which show optimal properties from the point of view of obtaining most exact results is presented. These considerations are based on the analysis of the action of a chopper equipped with a large, but finished number of slots and bridges. The methods of calculation of parameters of the chopper are discussed and its construction is also described. At the same time the preliminary measuring results are presented. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

2786 (AEMC/Chem.Engg–127) ISOTOPE SEPARATION BY THE NOZZLE SEPARATION PROCESS. A Bibliography. Kahn, S.; Saleem, M. (Atomic Energy Minerals Centre, Lahore (Pakistan)). Mar 1973. 75p. Dep. NTIS (U. S. Sales Only) $5.75.

The enrichment or separation of certain isotopes, e.g., D and ^{235}U, is important in the production of nuclear energy. For the enrichment of uranium isotopes, at present the gaseous diffusion method is being employed. Two other methods which are being extensively studied for this purpose are the gas centrifugation method and the separation nozzle process, also known as the jet separation method or the Becker method. In the nozzle separation process, a gaseous mixture of isotopes is introduced at high speed into a nozzle from which it emerges in the form of an expanding supersonic jet. The core region of the jet is separated from its peripheral region with the help of an annular diaphragm. It has been found that the peripheral region has a greater concentration of the lighter isotope while the central part is more enriched in the heavier isotope. In this bibliography, a total of 112 references have been collected on the separation nozzle process. The references have been arranged chronologically, and within the same year, alphabetically according to the name of the first author. An author index is included. (auth)

2787 (INIS-mf-587) URANIUM ENRICHMENT PROCESSES: AN ANNOTATED BIBLIOGRAPHY (1957–1969). Malwad, N. M. (Comp.). (Bhabha Atomic Research Centre, Bombay (India)). 1970. 100p. INIS.

The bibliography includes 192 references on the three major enrichment processes, for uranium, namely, gaseous diffusion, centrifuge, and nozzle separation processes, published during the period 1957 to 1969. It is based on Nuclear Science Abstracts, ZAED abstracts, reports collection of the Depository Library, Bhabha Atomic Research Centre, Bombay, periodical articles, papers presented at the conferences, symposia etc. and also books published during the period 1957 to 1969. The entries are classified broadly under the enrichment processes and are sub-divided under major aspects such as technology, uranium enrichment, economics etc. The contents page provides full subject categorization. Under each subject heading, the entries are arranged alphabetically according to the author's name. For each entry, the minimum required bibliographic data such as first two authors, title, sub-title, report number, bibliographic citation, year of publication, and abstract are provided. Language of the document, if not English, is indicated within brackets after date of publication. Availability of the reports in the Depository Library is indicated. The periodical abbreviations are the same as followed by NSA. Cumulative author, report number, and subject indexes are provided. (INIS)

2788 (RT/ING–(72)18) HEAVY WATER PRODUCTION. Industrial Processes and Plants. (A Bibliography). Lavrencic, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 14 Sep 1972. 389p. Dep. NTIS (U. S. Sales Only) $21.50.

The bibliography covers the literature published on heavy water production. The material is arranged under the following subject headings: General, Bibliographies, Determination and Analyses of Deuterium and Heavy Water, Heavy Water Production (processes, patents, plants, technical and economical aspects), Heavy Water Reactors, Conferences on Heavy Water and Heavy Water Reactors. Two summary tables on heavy water production plants and HWRs in the world, and some schemes of the production plants are also included. (auth)

2789 METHOD FOR THE CONSTRUCTION OF THE NOZZLE WALLS OF SEPARATION NOZZLES. Grosstueck, W. (to Firma Weber (Klaus D.)). German Patent 1,908,693. 1 Feb 1973. 3p. (In German).

A fabrication method for separation nozzles with turnaround channels for the separation of gases or vapors with different molecular weight, in particular to the construction of the nozzle walls, is described. (GF)

2790 MOTION OF SMALL SPHERES IN GASES. 4. Diffusion Coefficient of Porous Membranes. Williams, M. M. R. (Queen Mary Coll., London). J. Phys., D (London); 6: No. 6, 759-773(9 Apr 1973).

The formalism for scattering by spherical particles has been used for a study of the diffusion coefficient and separation efficiency of the porous membranes used in separating isotopes and gas mixtures. The membrane, or barrier, is replaced by the randomly dispersed sphere model, thereby enabling the ideas developed in earlier papers of this series to be employed. Calculations are made in the Knudsen regime, and from an asymptotic solution to the Boltzmann equation for gas flow in the barrier an expression is obtained for the diffusion coefficient in terms of an average over the solution of a certain integral equation whose kernel is determined by the barrier properties. The integral equation is solved by perturbation and variational methods, and the results indicate that, of the conventional gas-surface interaction parameters, it is the tangential momentum accommodation coefficient which is most effective in determining barrier efficiency. The energy accommodation enters only in a minor fashion. In general, it is found that the larger the tangential coefficient, the smaller is the diffusion coefficient, while the energy accommodation acts in the opposite sense although to a smaller extent. The limitations of the "dusty-gas" model are stressed by comparison with exact results. (auth)

2791 ISOTOPE EXCHANGE PROCESS. Richardson, R. D. (to General Electric Co. Ltd.). Canadian Patent 911,137. 3 Oct 1972.

A process for manufacturing heavy water by utilizing isotopic exchange between water and hydrogen sulfide is claimed. The isotopic exchange takes place in at least two stages, each of which is performed (preferably) in packed towers. The packed towers have a hot lower section and a cold upper section. The first stage is divided into an "original" first stage and a "supplementary" first stage. In the "original" first stage, water enters at the top, is enriched by hydrogen sulfide from the second stage, and then is depleted again, and runs to waste. Hydrogen sulfide in the "original" first stage is enriched, passes to the second stage for depletion, and then undergoes further depletion on its return. In the "supplementary" first stage hydrogen sulfide circulates in a closed system, but water is alternately enriched, passed to the second stage, and depleted on its return. Advantages of the process are the small volume of the second stage, and interchangeability of the units of the first stage. (CA)

Isotopic Power Sources

2792 IMPROVEMENTS IN OR RELATING TO THERMOELECTRIC UNITS. Penn, A. W.; Neighbour, F. (to United Kingdom Atomic Energy Authority). British Patent 1,303,835. 24 Jan 1973. Filed date 30 Jan 1970. 6p.

A method for the manufacture of a thermoelectric unit is described that is comprised of a number of thermoelectric elements with a sheet of paper interposed between and contiguous with adjacent elements, together with a plastic settable bonding medium. Pressure is applied to the assembly while the bonding medium is plastic, so that it flows into the pores of the paper, and pressure is maintained until setting has occurred. Separation of adjacent elements is determined by the thickness of the paper. The thermoelectric elements preferably comprise Bi telluride based semiconductor material alternately of P- and N-type. The unit may be incorporated in a thermoelectric battery for a cardiac pacemaker. (UK)

2793 INTERNALLY MODERATED HEAT SOURCES AND METHOD OF PRODUCTION. Mayo, K. E.; Fretague, W. J. (to Sanders Nuclear Corp.). U. S. Patent 3,725,663. 3 Apr 1973. Filed date 27 Jan 1970. 6p.

Internally moderated neutron activation targets are formed of a mass of a stable metal hydride such as thulium hydride preferably in a surrounding casing of a material having a low thermal neutron cross section and a short half life. Heat sources are formed from the targets by irradiation with neutrons with the hydrogen atoms acting as a moderator to reduce the effect of flux depression during neutron activation. (Official Gazette)

Radiation Sources

Refer also to abstracts 2126, 2148, 2606, and 2670.

2794 (EUR–4896(Vol.1), pp 447–456) SPECTRA OF NEUTRON SOURCES. Kluge, H.; Weise, K. (Physikalisch Technische Bundesanstalt, Brunswick). Sep 1972. (In German).

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The neutron spectrum of a Ra-α-Be-source has been investigated by means of a recoil proton telescope in the energy range above 1.4 MeV. The energies of the protons released by the neutrons from a thin tristearin radiator layer are determined by a

surface barrier detector. Applying the theoretical proton response function for monoenergetic neutrons the neutron spectrum is calculated by unfolding the measured recoil proton distribution. Comparing this spectrum with that of an ^{241}Am-α-Be-source also measured one can see that both spectra are similar. The differences are discussed. (auth)

2795 (EUR-4896(Vol.2), pp 955-963) NEGLECTED ENERGY RANGE. Harvey, J. R.; Beynon, S. (Berkeley Nuclear Labs., Eng.). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

A statistical analysis of the dose spectra in many working environments around nuclear reactors shows that a significant fraction of the neutron dose equivalent is due to neutrons within the energy range thermal to 25 keV. Because of the difficulty of producing suitable monoenergetic neutron sources, instruments are rarely calibrated in this energy range and biological data are sparse. A plea is made for more attention to be paid to this energy range. In order to stimulate interest, attempts to produce monoenergetic sources in this region are reviewed and a new source is described in which a spherical water moderator is used to modify the source spectrum from an Sb/Be source. (auth)

2796 (NP-19749) IRRADIATION AND CALIBRATION PLANT AT THE NORWEGIAN AGRICULTURAL COLLEGE. Sand, K. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Mar 1973. 22p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $3.25.

The irradiation facility at the Norwegian Agricultural College is used both for development of plant mutants and for calibration of radiation measuring equipment for both military and civil defence. The present ^{60}Co source has an activity of 60 Ci (1971). The facility is situated at the Agricultural College at Ås, near Oslo. The source is placed at the lower end of a cylindrical shield plug and when not in use is lowered into a concrete shielded pit. When in use it is raised to 1 m over ground level inside a cylindrical lead shield with a collimator opening. Extra shielding allows access to the lifting mechanism while the source is in use. The source and main shielding is situated in a light wooden building and the lifting mechanism some 6 to 8 m from the source building, behind a concrete wall. The control panel is situated by a small service building, outside the main fence, 55 m from the source building. With the source raised the dose rate in the beam is 100 R/h at 0.7 m, behind the shield 20 m R/h, at the lifting mechanism 0.25 m R/h and at the fence 0.5 m R/h. When the source is in the well the dose rate is not significantly above background. Two collimators are available with lateral opening angles of 50° and 15.5° and vertical opening angles of 31° and 12° respectively. The warning system is based on a single GM tube with visual alarm only. The lamp flashes when the radiation level shows the source to be raised. Position indication is also given by the lifting mechanism. Both lifting mechanism and alarm systems are mains powered and, while the source is small and the site isolated, it is proposed to install an alarm for mains failure. (NO)

2797 NUCLEAR TECHNIQUES APPLIED IN HYDROMETALLURGICAL TESTING. Urbanski, T. S.; Rowinska, L. Rudy Metale Niezelaz.; 18: No. 2, 52-61(1973). (In Polish).

An attempt was made to assess the possibility of applying nuclear techniques, chiefly tracer methods, using both radioactive and non-radioactive isotopes, including activity measurements, and also employing the radiometric analysis of polymetallic materials to the study of processes occurring in the hydrometallurgical treatment of rare element-bearing raw materials and intermediate products. The possibility is considered of utilizing these methods in industrial and laboratory scale studies of the physical chemistry of such processes as flotation, leaching, sorption, liquid-liquid extraction, precipitation and co-precipitation and electrolysis in aqueous solutions. A survey of radioactive techniques hitherto used in hydrometallurgical investigation is given and the conditions and principles involved in their application to the processes mentioned are discussed. A brief description is given of an industrial radioisotope apparatus used for hydrometallurgical process control. (auth)

2798 NUCLEAR TECHNIQUES IN ART AND ARCHAEOLOGY. Casa, A. F. Com Naz. Energ. Nucl., Notiz.; 19: No. 1, 15-20(Jan 1973). (In Italian).

The applications of nuclear techniques for the conservation of art resources by preserving art works from chemical and biologic environmental contamination are discussed. (tr-auth)

Design and Fabrication

2799 DIRECTIONAL THERMAL NEUTRON EMITTER. Fominykh, V. I.; Migun'kov, O. A. At. Energ. (USSR); 31: No. 6, 624(Dec 1971). (In Russian).

This paper was summarized as paper No. 550/6275 with full copy held by TIC.

A thermal neutron emitter (the projector) is described in which the thermal neutron flux is increased and its quality is improved by using a source of monoenergetic low-energy neutrons and a hydrogenous reflector. The emitter consists of a moderator of a block of paraffin whose inner surface serves as a reflector. An open tube containing the neutron source and a cylindrical moderator is coaxial with the reflector. Various types of neutron sources can be used in the emitter. The dimensions of the cylindrical moderator are determined by the thickness necessary to thermalize the source neutrons, and the layer necessary to slow down the neutrons to energies ~1 keV. The emitter was compared with a 15 cm diameter paraffin sphere by using a long counter. A miniature proportional boron counter was used to investigate the distribution of the thermal flux from the emitter along the axis and in the transverse direction. The thermal flux was measured at a point on the axis 50 cm from the center of the source by manganese-nickel foils. Knowing the thermal flux and the total flux of source neutrons, it was possible to determine the total flux of source neutrons necessary to produce a unit thermal flux at a given point on the axis of the emitter. (auth)

2800 PREPARATION OF HIGH-LEVEL ALPHA-PARTICLE SOURCES FOR THE SURVEYOR ALPHA SCATTERING EXPERIMENT. Patterson, J. H.; Griffin, H. E.; Horwitz, E. P.; Bloomquist, C. A. A. (Argonne National Lab., IL). Nucl. Technol.; 18: No. 3, 277-285(Jun 1973).

Thin, high intensity alpha-particle sources were prepared for the NASA Surveyor Alpha Scattering Experiment. The alpha-active isotope used for this experiment was ^{242}Cm prepared by neutron irradiation of ^{241}Am in a reactor. After irradiation the curium was separated from americium, fission products, and aluminium by liquid-liquid extraction, redox precipitation, and extraction chromatography techniques. The sources were prepared by vacuum sublimation of the curium onto stainless-steel plates, followed by carbon coating from a carbon arc and encapsulation for installation into the Alpha Scattering Instrument. (auth)

Industrial Uses

Refer also to abstracts 2845, 2846, and 2981.

2801 (BFL-4/1972) INVESTIGATION OF INDUSTRIAL PROCESSING AND STORAGE OF IRRADIATED POTATOES AND ONIONS. Penner, H.; Gruenewald, Th.; Rumpf, G.; Gehse, M. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany)). Sep 1972. 38p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

Experiments on industrial processing of irradiated potatoes were continued. For the production of potato chips, potatoes of the Saturna and Tasso varieties were partly irradiated with 8 and 15 krads bremsstrahlung and partly treated with a mixture of chlorprophame (CIPC) and prophame (IPC). After treatment, potatoes were stored in 1 m^3 crates for seven months. Contrary to previous experiments performed under similar conditions with the Saturna variety, both varieties showed only a small amount of rotting. Chips of good quality were produced from irradiated and from unirradiated potatoes. Potatoes of the Hansa and Hela varieties were treated in the same manner as in the first experiment, stored for six months in crates and processed to heat-sterilized vacuum packed potatoes. The percentage of rotted tubers was high and was increased by irradiation. Nevertheless, products of good quality were obtained from each lot. Discolorations were found to depend more on variety than on irradiation. A storage experiment was also carried out with irradiated onions. Onions of the Zittauer and Hybride varieties were stored. One-third of this quantity remained unirradiated while two-thirds received doses of 4 and 8 krads bremsstrahlung. After 8 months of storage the irradiated onions were in good condition, whereas the untreated ones were fully rotted. (auth)

2802 (BNWL-1726) FEASIBILITY OF A LARGE GAMMA IRRADIATOR AS A HOSPITAL STERILIZATION FACILITY. McKee, R. W.; Owzarski, P. C.; Butcherite, C. D.; Frymier, J. W. (Battelle Pacific Northwest Labs., Richland, Wash.). 17 Jan 1973. Contract AT(45-1)-1830. 182p. Dep. NTIS $3.00.

Results of a study undertaken to identify possible applications and the feasibility of a gamma irradiation facility applied to the sterilization requirements of a large hospital are reported. The scope of the information-gathering phase of this study included an extensive literature search; a survey of eight Bay Area hospitals; a visit to the University of Western Ontario Hospital in London, Ontario, Canada, where a large irradiation facility is under construction; a visit to the Atomic Energy of Canada,

Limited, in Ottawa; discussions with various public health officials, pollution control officials, and hospital officials; attendance at a USP Conference on Radiation Sterilization; and attendance at a Hospital Waste Management Seminar at George Washington University. The most promising applications for a hospital irradiator identified in the information-gathering phase were analyzed in detail to determine the feasibility of such a facility. The analyses included a scope design and cost estimates for construction and operation of the irradiator. The final list of most promising candidates included inhalation therapy materials and equipment, most items presently gas sterilized, disinfecting treatment for linens, and infectious wastes. (TFD)

2803 (TID-26287) STUDY OF COATING DISTRIBUTION USING MICROTOME SECTIONING AND NEUTRON ACTIVATION ANALYSIS. Grant, G. A.; Clifton, G. S. (Washington State Univ., Pullman. Radioisotopes and Radiations Lab.). 13 Mar 1973. 23p. Dep. NTIS $3.25.

The application of neutron activation analysis for studying the depth and distribution of various coatings on paper is described. (TFD)

2804 IMPROVEMENTS IN OR RELATING TO UNSATURATED POLYESTER-BASED COATING COMPOSITIONS. Crimlisk, D. J.; Wright, A.; Groves, T. E. (to Sissons Brothers and Co. Ltd.). British Patent 1,295,043. 1 Nov 1972. Filed date 15 Nov 1968. 10p.

Reference is made to processes for curing organic resin coating compositions by electron irradiation. High-energy radiation has been used for this purpose, which involved crosslinking, but this is not commercially competitive on a cost basis with other methods such as the use of heat and/or catalysts, and it has been proposed to use low-energy electrons (<250 keV) for the purpose, in an attempt to make the process competitive. It has been found that if the coating composition contains an unsaturated polyester of average molecular weight 800 to 1500 the low-energy process is successful. The resin should contain a level of aliphatic unsaturation of at least 3.5 double bonds per 1000 g, and be dissolved in at least one reactive olefinically unsaturated co-monomer. Irradiation causes cross-linking of the resin by the co-monomer; and the electron energy is preferably 125 keV. The unsaturated polyester resin is prepared from a diol as propylene, mono-ethylene or diethylene glycol, 1:4-butene diol or allyl ether, or a cyclic diol such as cyclohexane, and an acid such as phthalic, isophthalic, adipic, maleic, fumaric or tetrahydrophalic acid, and the olefinically unsaturated co-monomer may be styrene, methyl methacrylate, N-vinyl pyrrolidine, 2-vinyl pyridine, dibromostyrene, divinylbenzene or triallyl cyanurate, or mixtures therefore. The unsaturated polyester resin may be admixed with pigments, and may also contain substances such as silicone fluid, cellulose acetate, polyethene wax, etc. Examples of application of the process are described. (UK)

2805 PRESENT STATUS OF INDUSTRIAL APPLICATION OF ISOTOPE AND RADIATION TECHNIQUES IN JAPAN. Kato, M. (Tokyo Univ.); Kobayashi, M.; Enomoto, S.; Hirayama, T.; Iijima, H. Proc. Jap. Conf. Radioisotop.; No. 10, 581-591(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Progress in developing industrial uses of radioisotopes and radiation techniques is reviewed. Advances in the development of radiometric level and thickness gages; the application of neutron moisture gages to concrete mixing; uses of radioisotope x-ray fluorescence analysis; development of a dew point hygrometer; the application of new sources to γ-ray radiography and an evaluation of the image quality obtained; in-situ tracer techniques; the use of activation analysis in environmental pollution studies; and the use of activation analysis coupled with computers for nondestructive analysis are discussed. Industrial fields in which these techniques are used include the iron and steel industry, nonferrous metal industry, chemical industry, machinery and electrical industries, and civil engineering. (JA)

2806 METHOD FOR MEASURING QUANTITIES ASSOCIATED WITH THE FILLER DISTRIBUTION OF PAPER. Kuusi, E. J.; Lehtinen, A. I. (to Valmet Oy). Canadian Patent 911,621. 3 Oct 1972. Priority date 1 Apr 1967, Finland.

A method for continuously measuring the one-sidedness of the application of a filler to paper is described. X-ray fluorescent analysis is used to analyse the paper for filler components. By using an alpha source such as ^{210}Po, the filler on one side of the paper only may be excited to emit characteristic x-rays; the result is compared with the total analysis obtained by exciting fluorescence with x-rays, gamma rays, or (preferably) a beta source such as ^{3}H-Ti, ^{3}H-Zr or ^{55}Fe. A proportional counter to measure the characteristic x-rays emitted is preferred. (CA)

2807 TRACING OF WEARING PROCESS BY ^{198}Au RADIOACTIVE PIN. Mizuno, M. (Inst. of Physical and Chemical Research, Wako, Japan). Seimitsu Kikai; 38: No. 11, 908-915 (Nov 1972). (In Japanese).

Characteristics of wear curves are analyzed by tracing of radioactive ^{198}Au wear particles. The quantity and the location of wear particles are detected by this method, and also it becomes clear whether the wear particles are transferred on the mating surface, or transferred back to an original test pin, or removed from the rubbed surfaces. The conclusions obtained from the experiments are summarized as follows: (1) the quantity of wear of a pin is determined as the arithmetic sum of the quantities of transfer and removal of wear particles. Namely, the difference between the rates of transfer, removal and back transfer governs the virtual rate of the pin; (2) generally, the transferred particles adhere strongly to the mating surface, consequently are not readily removed. Moreover, most of the particles removed are borne directly from the rubbed surface of a pin; (3) in the special conditions, a little quantity of removal of the transferred particles occurs, and it causes the marked increase in the wear loss of a pin. However, when the back transfer is predominant, it will be negative wear loss, and; (4) the avalanche phenomena of transferred particles occur when the quantity of transferred particles becomes over the certain limited quantity. This means the sudden decrease of the transferred wear particles. (auth)

2808 METHOD AND APPARATUS FOR DETERMINING COMMUNICATION OF A PERFORATED ZONE WITH A SECOND ZONE. Vann, R. R. U. S. Patent 3,710,114. 9 Jan 1973. Filed date 25 Jan 1971. 8p.

A method is described for locating the presence of passageways formed longitudinally from a borehole which communicates a production zone with a second zone, by placing isotopes adjacent to the well casing at spaced locations above and below the perforated zone, and by placing other isotopes adjacent the borehole annulus above and below the perforated zone of the borehole. The first spaced isotopes have a half life or decay rate substantially different from the other isotopes, and accordingly, translocation of either of the isotopes may be traced with radiation measuring apparatus. The apparatus includes means for affixing one isotope adjacent the casing, and further includes means for holding the remaining isotope adjacent the borehole wall, so that each of the different isotopes are horizontally spaced by the cement which attaches the casing to the borehole wall. (Official Gazette)

2809 RADIATION PROCESSING OF WHOLE EVISCERATED CHICKEN CARCASSES. Kiss, I.; Farkas, J. Acta Aliment.; 1: No. 1, 73-86(1972).

The aim of the experiments was to assess the means of extending the storage life of whole eviscerated chicken carcasses by ionizing radiation at exposure levels not impairing the sensory quality of the meat. Eviscerated whole carcasses weighing 0.8 to 0.9 kg were sealed into shrink foil and irradiated with 0.2 to 0.5 Mrad gamma rays from a ^{60}Co radiation source. Foil-packed carcasses exposed and not exposed to irradiation were then stored at 0 to +4°C. Lots of 25 carcasses were treated at each dose level. During storage both the deterioration of the sensory quality and the change of the total viable cell count were followed. At given intervals of the storage period unspoiled raw samples as well as cooked and fried samples were subjected to sensory evaluation by a jury. Irradiation with 0.2 to 0.5 Mrad was found to extend the keeping quality of chicken carcasses in cold storage 2 to 3 times or at least for 10 to 15 days without notable deterioration of sensory quality. Preliminary examinations showed the above radiation treatment to practically eliminate Salmonella infection of the carcasses. (auth) (Hung. Tech. Abstr.)

2810 SUGAR METABOLISM AND VITAMIN C AND PP CONTENTS IN IRRADIATED AND CHEMICALLY TREATED POTATOES. Baraldi, D. (CSN, Casaccia, Italy); Guerrieri, G.; Miuccio, C. F. Agrochimica; 538-545(1972). (In Italian). (RT/BIO-(72)35).

Potatoes of Bintje variety were irradiated with ^{60}Co at 10 krad: contemporarily, potatoes of the same variety were treated using 10 ppM of a chemical antisprouting substance (IPC:CIPC). The samples were stored at the temperature of 10°C and 85-90% of relative humidity. The glucide metabolism was checked by measuring the variations in the content of total and reducing sugars and sucrose during a 10 month storage. The irradiation process was found to affect the amount of reducing sugars, particularly during the first months of storage: they were greatly increased, as compared with the chemically treated samples and the controls. Irradiated potatoes did not present any change in the content of total sugar and sucrose. No significant variation was even found in the vitamin C and PP levels. The presence of different kinds of rot according to the irradiation dose, to anticryptogamic

treatments and to storage conditions were also described in this paper. (auth)

2811 RK-M1 RADIATIVE LOOP MODEL CONSTRUCTION FOR DOSE FIELD INVESTIGATION IN INDUSTRIAL RADIATION SOURCES. Kal'kis, V. Ya.; Tomson, E.; Rayavee, E.; Dindun, A. (Inst. of Wood Chemistry, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 6, 3-8(1972). (In Russian).

A method for simulating a radiation loop of an industrial irradiator with an In γ-carrier is presented and a RK–M1 radiation loop model was constructed, based on the circulation of an In alloy solution activated in the critical assembly. The operation data of the RK generator, the irradiator, and the radiation loop are presented. (auth)

2812 STUDIES ON THE MANUFACTURE OF LOW DP PULPS BY IRRADIATION. 5. "No-aging" Viscose Process for Irradiated Pulps. Veno, Takeo (Sanyo Pulp Co. Ltd., Iwakuni, Japan); Murakami, Masahiro; Imamura, Rikizo. Kami Pa Gikyoshi; 26: No. 4, 164-172(Apr 1972). (In Japanese).

An attempt at the simplification of viscose rayon process is described in which low DP pulps obtained by irradiation were used to study the basic conditions for the viscose process in which "aging" can be omitted. The following standard conditions were defined on a laboratory scale: mercerization is carried out only with the required minimum amount of alkali (20% NaOH, 50°C, 5.6 times as much as pulps); the proper number average DP of pulps to be used for "no-aging" process is 440 ± 5; and for the third or fourth time of circulation of recovered alkali, a corresponding amount of whole pulps is converted into viscose. From three kinds of gamma-irradiated pulps (varied α-cellulose contents), viscoses in which corresponding amount of whole pulps used in each experiment contained were prepared by means of the "no-aging" method accompanied with reuse of recovered alkali. The properties of these viscoses showed little abnormality except that the viscose prepared from low α-cellulose pulps has somewhat worse filterability. Further, the properties of rayon staple fibers obtained from these three kinds of viscoses were examined and it was observed that some properties become more or less worse as hemicellulose contents in fibers get higher. However, this deterioration of fiber properties may not be worth consideration from the practical viewpoint. Finally, viscoses were prepared from five kinds of electron-irradiated pulps (varied uniformity of irradiation) by means of the "no-aging" method, and even the irradiated pulps in which maximum–minimum ratio of absorbed dose was 1.9 were used, properties of viscose were similar to those from conventional methods. (auth)

2813 MODERN POSSIBILITIES OF WEAR MEASUREMENT USING RADIONUCLIDES. Lausch, W. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 4: No. 4, 20–26(1972). (In German).

The principle of thin-layer activation by charged particles from an accelerator and the so-called thin-layer difference method for wear measurement of machine parts are briefly discussed. (GF)

2814 APPLICATION OF RADIOISOTOPES IN ELECTROPLATING. Stverak, B. (Inst. for Research, Production, and Application of Radioisotopes, Prague). Koroze Ochr. Mater.; 15: No. 4, 80-81(1971). (In Czech).

A brief review is given of the application of radioisotopes in various fields of electroplating techniques. They make possible the investigation of various processes and properties of final products, such as the application of quantitative radiography in determining the coating uniformity and homogeneity, the application of isotopes deposition in the study of the kinetics of dissolution of metals or their depositions, the application of labeled substances in the study of the effect of various additions on metal etching and polishing. These methods are especially suitable for handling microamounts and extremely thin layers, when other methods cannot be applied. Radioisotopes are very suitable for the study of diffusion processes in surface layers. Nondestructive testing of final products as well as the study of hydrodynamic conditions and the effect of geometrical arrangement during electroplating are facilitated. (Nucl. Sci. Abstr. Czech)

LIFE SCIENCES

2815 (AEC-tr-7421) RADIOBIOLOGY, VOL. 12, NO. 6, 1972. Translation of Radiobiologiya; 12: No. 6, 803-960(1972). 198p. Dep. NTIS $7.60.

Separate abstracts were prepared for 31 of the 32 papers in this cover-to-cover translation. The other paper discussed the content of nicotinamide coenzymes in the subcellular fractions of the liver and in the blood of rats after administration of β-mercaptoethylamine. (ERB)

For abstracts of individual papers see: 2679, 2817–2819, 2833–2840, 2855–2857, 2913–2925, 2978, 2990, and 4396.

2816 (WASH-1200(72)) RESEARCH CONTRACTS IN THE LIFE SCIENCES. (Division of Biomedical and Environmental Research, Washington, D. C.). 1 Jul 1972. 83p. USAEC Div. of Biomedical and Environmental Research, Washington, D. C.

Radiation Effects on Biochemicals

Refer also to abstract 2935.

2817 (AEC-tr-7421, pp 24-32) PROPERTIES OF CHROMOSOMAL DEOXYRIBONUCLEOPROTEIN COMPLEXES FROM THE ORGANS OF IRRADIATED ANIMALS. Likhoded, V. S.; Stolyarov, I. V.; Ishkhanova, M. A.; Savenko, L. N.; Fonarev, A. B.; Paskevich, I. F. (Scientific Research Inst. of Medical Radiology, Kharkov). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 819-825 (1972).

The metabolism of the proteins extractable at various concentrations of NaCl from deoxyribonucleoproteins (DNP) from the livers and spleens of rats x-irradiated at a dose of 800 R was investigated. It was established that an increase in the incorporation of a ^{14}C-protein hydrolyzate into all the investigated fractions is observed in the liver after irradiation, with the exception of 96 and 120 hrs, when this process is suppressed. In the spleen, at all periods of the experiment, a drop in the specific radioactivity is observed. In both organs in the long-term periods of radiation sickness (96 and 120 hrs), there are changes in the histones and DNP, expressed in a disruption of their interaction. (tr-auth)

2818 (AEC-tr-7421, pp 33-38) SPECTRAL AND ELECTROPHORETIC CHARACTERISTICS OF HEMOGLOBIN OF GUINEA PIGS IRRADIATED AT A DOSE OF 600°R. Zdravko, B. I. (Lvov State Univ.). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 826-829(1972).

The absorption spectra and electrophoretic mobility of hemoglobins isolated from the blood of x-irradiated guinea pigs were investigated during the dynamics of acute radiation sickness. A decrease in the intensity of the absorption of aqueous solutions (pH 5.87) of hemoglobins of the irradiated animals in the region of 275 mμ was demonstrated. No traces of methemoglobin were detected. A progressive slowdown of the electrophoretic mobility of hemoglobin of irradiated guinea pigs was detected by the method of disc electrophoresis in polyacrylamide gel. (tr-auth)

2819 (AEC-tr-7421, pp 39-45) NATURE OF THE DAMAGE TO THE STRUCTURE OF MOUSE OXYHEMOGLOBIN DURING UV IRRADIATION. Artyukhov, V. G.; Shmelev, V. P. (Voronezh State Univ., USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 830-834(1972).

The spectral characteristics and intensity of light scattering in uv-irradiated solutions of mouse oxyhemoglobin were investigated. It was found that the process of damage to oxyhemoglobin under the influence of long-wave uv radiation occurs with a quantum yield of $3.1 \cdot 10^{-2}$. After the influence of an integral flux of uv rays, there is a substantial increase in the light scattering in aqueous solutions of oxyhemoglobin, which is due to aggregation of its denatured molecules. Ultraviolet-irradiated molecules of free heme also undergo aggregation. (tr-auth)

2820 (COO-3419-6) BIOLOGICAL AND CHEMICAL STUDIES ON PHYSICAL MUTAGENS. Progress Report, August 1, 1972–July 31, 1973. Person, S. (Pennsylvania State Univ., University Park. Dept. of Biophysics). [nd]. Contract AT(11-1)-3419. 8p. Dep. NTIS $3.00.

Progress is reported in the area of transmutation effects of tritium decays from nucleic acid precursors. Single-strand breaks in bacterial DNA stored in vitro were four times more frequent per decay when decay occurred as cytosine-6-^{3}H as opposed to cytosine-5-^{3}H. Single-strand breaks specifically associated with decays from 6-position pyrimidines were efficiently repaired in bacteria. Graphs are presented to show survival of bacteria as a function of accumulated tritium decays. (HLW)

2821 (RLO-2225-T-15-15) PHOTOBIOLOGY AND PHOTOCHEMISTRY OF RIBONUCLEIC ACIDS. Progress Report for the Period March 1972–March 1973. Gordon, M. P. (Washington Univ., Seattle). [nd]. Contract AT(45-1)-2225. 8p. Dep. NTIS $3.00.

Studies were conducted on in vitro photoreactivation of ultraviolet-inactivated tobacco mosaic virus RNA from extracts of Nicotiana tabacum. Bacterial extracts were used for studies on photoreactivation of infectivity of uv-inactivated viral RNA, reversal of pyrimidine dimer formation in ^{14}C-labeled RNA, and in vivo photoreactivation of viral RNA in Escherichia coli. Studies were also conducted on photorepair induced by tryptophan and tryptophanyl residues in proteins, action of sunlight, and photobiology and photochemistry of RNA viruses. Studies using whole plants included photoreactivation of uv-inactivated RNA viruses, effects of ultraviolet light on seedlings, and effects of ultraviolet light on tRNA in Xanthi leaves. (HLW)

2822 (TID-26307) REPAIR OF ULTRAVIOLET LIGHT-INDUCED DAMAGE TO THE DNA IN WILD-TYPE AND ULTRAVIOLET SENSITIVE STRAINS OF NEUROSPORA CRASSA. Worthy, T. E. (Tennessee Univ., Knoxville). Dec 1972. 122p. Dep. NTIS $8.25.

Thesis.

A method was devised for labeling a specific pyrimidine in the DNA of N. crassa. In cells grown in the presence of (5-^{3}H)-uridine, more than 97 percent of the radioactivity associated with the DNA had been incorporated into cytosine. The specific activity of the labeled DNA was approximately 3×10^3 counts per min per μg. The DNA was isolated by elution from hydroxyapatite columns with 0.40 M sodium phosphate buffer (pH 6.8). This procedure was used to demonstrate that in vegetative cells of N. crassa, both photoreactivation and excision repair are operative, as measured by the removal of uv-induced cytosine-containing dimers. Post-irradiation incubation with several chemicals known to inhibit various repair systems indicated that caffeine reduced the rate of excision by two-fold, but did not inhibit excision completely as did proflavine and quinacrine. Examination of the rate of excision indicated that repair occurs at a relatively rapid rate; approximately 60 dimers are excised per minute after 500 ergs mm^{-2}. Further evidence for the rapidity of excision was obtained by sedimentation analysis of DNA during repair; the maximum number of breaks introduced during repair was three, indicating that breaks are repaired almost as fast as they are made and that only a few dimers are repaired at a time. Repair synthesis was measured by labeling the DNA with ^{15}N and D_2O and then subjecting the DNA to equilibrium density gradient centrifugation, subsequent to post-irradiation incubation with ^{32}P. All available uv-sensitive mutants of N. crassa were examined for their ability to excise and photoreactivate cytosine-containing dimers in vivo. All strains demonstrated in vivo photoreactivation, including upr-1, which was originally thought to be deficient in photoreactivation. Three strains, uvs-2, uvs-4, and upr-1 were shown to be deficient in excision; uvs-3 was shown to contain a residual amount of excision capability. The remaining strains, uvs-1, uvs-5, and uvs-6, were normal in their ability to excise dimers. Based on these results, tentative analogies were drawn between the Neurospora mutants and the known classes of bacterial uv-sensitive mutants. (HLW)

2823 X-RAY INACTIVATION IN SOLUTION OF RENNIN FROM MUCOR PUSILLUS. Kovacs-Proszt, G.; Sanner, T. (Norwegian Radium Hospital, Oslo). Radiat. Res.; 53: No. 3, 444-454(Mar 1973).

Rennin from Mucor pusillus was irradiated in 0.1 M phosphate buffer in the presence of air at 20°C. The enzyme was inactivated with a yield corresponding to G = 0.36 at pH 6.4. The extent of inactivation was the same whether the activity was measured from the ability of the enzyme to clot milk or from the enzymatic aggregation of κ-casein. Evidence was obtained that the inactivation was due to reaction of OH radicals with the enzyme. The rate of interaction of the OH radical with the enzyme was calculated to be 2.1×10^{10} M^{-1} sec^{-1}. Disc gel electrophoresis of the macropeptides released upon incubation of native and irradiated enzyme with acid casein and κ-casein revealed no effect of irradiation on the products. Thus, the specificity of the enzyme seems to be unaffected by irradiation. The radiation inactivation was associated with a significant after-effect as well as with a decrease in the normal heat stability of the enzyme. The enthalpy of activation and increase in entropy for the aftereffect was independent of the extent of radiation inactivation, while ΔH^* and ΔS^* for the heat denaturation of the enzyme decreased. Addition of cysteamine after irradiation decreased both the rate and the extent of the aftereffect, as well as the rate of heat-denaturation. (auth)

2824 ULTRAVIOLET IRRADIATION OF THE COMPONENTS OF THE WHEAT EMBRYO IN VITRO PROTEIN SYNTHESIZING SYSTEM. Murphy, T. M.; Kuhn, D. N.; Murphy, J. B. (Univ. of California, Davis). Biochemistry; 12: No. 9, 1782-1789(24 Apr 1973).

In order to evaluate the sensitivities of the biological activities of plant RNA molecules to ultraviolet (uv) light, various components of protein synthesis were isolated from wheat embryos, irradiated, and then tested for their ability to support amino acid incorporation in an in vitro system. Messenger RNA was the component most sensitive to uv irradiation. The inactivation cross sections for two messengers, tobacco mosaic virus (TMV)-RNA and polyuridylic acid; were 50×10^{-5} and 68×10^{-5} mm^2/erg, respectively, compared to cross sections for wheat ribosomes, transfer RNA, and S100-DEAE (mixed enzymes without transfer RNA activity) of 7.0×10^{-5}, 1.0×10^{-5}, and 2.2×10^{-5} mm^2/erg, respectively. Wheat ribosomes were significantly more uv sensitive than Escherichia coli ribosomes. The ability of TMV-RNA to cause infection in tobacco was eight times more uv sensitive than was its messenger activity. (auth)

2825 α-S-CYSTEINYL-5,6-DIHYDROTHYMINE: A POSSIBLE MODEL FOR RADIATION-INDUCED CROSS-LINKING OF DNA AND PROTEIN. Varghese, A. J. (Ontario Cancer Inst., Toronto). Biochem. Biophys. Res. Commun.; 51: No. 4, 858-862(16 Apr 1973).

α-S-cysteinyl-5,6-dihydrothymine is identified as one of the major products of thymine irradiated in the presence of L-cysteine hydrochloride with ultraviolet light. The properties of this product are described. Since DNA-protein cross-linking is a major lesion in bacteria irradiated in the frozen state with ultraviolet light, photochemical addition of amino acid residues to the methyl group of thymine may play a role in uv-induced DNA-protein cross-links. (HLW)

2826 RADIATION BIOCHEMISTRY AND MEDICINE. Romantsev, E. Moscow; Meditsinskaya Gazeta (1972). 3p. (In Russian).

The role of biochemical processes in the effects of radiation on cells is discussed. Particular emphasis is placed on current knowledge about radiation damage to DNA molecules in conjunction with restorative enzyme systems and the possibility that radiotoxins form as a secondary effect of radiation. It is noted that ionizing radiation causes changes in the genetic apparatus of the cells and contributes to spontaneous and natural mutation responsible for the evolutionary process. One of the primary tasks for radiation biochemistry is deciphering the change in the substrate of the hereditary apparatus. The stimulating effect of radiation on enzyme activity is explained. The biochemical mechanisms of remote effects of ionizing radiation, which are divided into intumescent and nonintumescent forms, are discussed. It is believed that these are caused by a change in or loss of the nitrogen bases of DNA, which causes a change in the pyrimidine bases. It is mentioned that various effects can be produced by using different doses of radiation. (JPRS)

2827 MOLECULAR RADIOBIOLOGY. Ebert, M. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. Med. Bull.; 29: No. 1, 12-15(Jan 1973).

A brief outline review is made of the progress in the study of the early steps following energy absorption by living cells from ionizing radiations, relevance to the problem of increasing the radiosensitivity of malignant cells or reducing that of normal tissues. Particular mention is made to electron spin resonance studies of free radicals, pulse radiolysis as a tool for studies of reactions in the liquid state, response modifying factors such as conformational changes of macromolecules, excited molecules leading to fluorescence, phosphorescence and luminescence and solid state studies of amino acids, proteins, DNA bases and DNA. (UK)

2828 NEUTRAL SUCROSE GRADIENT SEDIMENTATION OF VERY LARGE DNA FROM BACILLUS SUBTILIS. 2. Double-Strand Breaks Formed by Gamma Ray Irradiation of the Cells. Hariharan, P. V.; Hutchinson, F. (Yale Univ., New Haven). J. Mol. Biol.; 75: No. 3, 479-494(15 Apr 1973).

A procedure was developed, whereby essentially all the DNA from Bacillus subtilis cells can be reproducibly extracted in a form that sediments 2.3 times faster than bacteriophage T2DNA in a neutral sucrose gradient spun at 20,000 revs/min. When the cells were irradiated with low (3 to 34 kilorads) gamma doses, some DNA moved in a slower peak, which from previous work (Levin & Hutchinson, 1973) appeared to be linear DNA. Some of the DNA also sedimented ahead of the unirradiated DNA. On incubation of the cells at 37°C under conditions such that single-strand DNA breaks were repaired, the fast-sedimenting component was partially restored, with the DNA sedimenting ahead of it usually disappearing, and the quantity in the slower component decreasing. With 80 min incubation, the fraction of DNA after various radiation doses in the fast-sedimenting component was the same as the fraction of cells able to form colonies, suggesting that the destruction of the component was responsible for the effect of gamma rays on the ability of a cell to replicate. Single-strand breaks introduced into the DNA within the cells did not affect the fast-sedimenting component, suggesting that radio-induced single-strand breaks are not responsible for the effect of gamma rays on replication. The double-strand break rate for DNA in the cells was 0.010 breaks per mass the size of T2DNA per kilorad. The fast-sedimenting component in irradiated cells that had not been incubated disappeared at a rate equal to one radiation-induced double-strand break formed per genome. Since the fast-sedimenting component in solution was also destroyed by one double-strand break per genome (Levin & Hutchinson, 1973), it is suggested that this component is the genome in the form of a circle, and the correspondence between DNA in the fast-sedimenting form after incubation and the ability of cells to form colonies then indicates that a genome can replicate only if all double-strand breaks are repaired. (auth)

2829 NUCLEOTIDE RADICAL OXIDATION AND ADDITION REACTIONS WITH CELLULAR RADIOSENSITIZERS. Greenstock, C. L.; Raleigh, J.; McDonald, E.; Whitehouse, R. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). Biochem. Biophys. Res. Commun.; 52: No. 1, 276-283(1 May 1973).

The yields of inorganic phosphate (iPO_4) released from deoxygenated solutions of irradiated purine 5′-mononucleotides are enhanced in the presence of low concentrations of oxygen, or such electron-affinic cellular radiosensitizers as p-nitroacetophenone and nitrofurans. The degree of radiosensitization increases with the sensitizer's electron-affinity, oxygen showing an approximately two-fold sensitization. Other electron-affinic cellular radiosensitizers, including the stable free radical triacetonamine-N-oxyl (TAN), protect against iPO_4 release, the degree of protection increasing with the sensitizer's electron-affinity. These findings are consistent with competition between nucleotide free radical oxidation and addition to sensitizer. Their relevance to mechanisms of radiosensitization is discussed. (auth)

Radiation Effects on Cells

Refer also to abstracts 2892 and 4421.

2830 UNSCHEDULED DNA SYNTHESIS IN HEN ERYTHROCYTE NUCLEI REACTIVATED IN HETEROKARYONS. Darzynkiewicz, Z. (Boston Biomedical Research Inst.); Chelmicka-Szorc, E. Exp. Cell Res.; 74: No. 1, 131-139(Sep 1972).

Unscheduled DNA synthesis induced by ultraviolet (uv) light irradiation, and presumed to indicate DNA repair replication, is not detected in dormant nuclei of hen erythrocytes. Erythrocyte nuclei reactivated in heterokaryons containing either HeLa cells or rat fibroblast nuclei resume unscheduled DNA synthesis within the first 16 h after cell fusion. The rate of unscheduled DNA synthesis increases further, parallel with nuclei reactivation (enlargement) in heterokaryons. Unscheduled DNA synthesis, which is resumed in reactivated nuclei, is not related to the possible induction of the enzymes of hen origin that are involved in DNA repair. Elimination of the transcription and translation of hen genome in heterokaryons does not impair reactivation of DNA repair replication in erythrocyte nuclei. No reactivation of unscheduled DNA synthesis was observed after fusion of hen erythrocytes with cells that are genetically deprived of the ability to repair DNA (Xeroderma pigmentosum fibroblasts). The results indicate that during erythrocyte nuclei reactivation the enzymes involved in DNA repair migrate from the heterokaryon's cytoplasm into the reactivated nuclei where they are functionally active. There is a lack of species specificity in this phenomenon. (auth)

2831 RADIATION-CHEMICAL APPROACH TO RADIOBIOLOGICAL EFFECTS ON MAMMALIAN CELLS. Okada, S. (Tokyo Univ.). Proc. Jap. Conf. Radioisotop.; No. 10, 429-430(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Using cells of mouse leukemia, which were cultivated and labeled with ^{14}C-thymidine, pulse radiolysis was performed in various alcohols at different concentrations, and the number of scissions of a single chain per cell was measured. The number was 7×10^4/cell/10 Krad without the presence of alcohol, and decreased to 2.1×10^4 with increasing concentration of alcohol. The relationship between the number and the concentration of alcohol took a different form in thiol. It was proved that kx (P_{50}) is constant and 3.3×10^8 sec^{-1} where k is constant of the reaction rate of DNA with OH radical of the alcohol, and (P_{50}) is the

concentration of alcohol when the number of scissions is equal to 3.05×10^4. The same relationship as described above did not apply to the case of the H radical or the hydrated electron. These results suggested that it is the OH radical that takes part in the scission in the case of indirect action. It was elucidated that the average lifetime of the OH radical is 2×10^{-9} sec in the cells and the average diffusion range is 82A. (Japan)

2832 OXYGEN ENHANCEMENT RATIOS IN HeLa CELLS IRRADIATED WITH CALIFORNIUM AND RADIUM SOURCES. Djordjevic, B.; Anderson, L. L.; Kim, S. H. (Sloan-Kettering Inst. for Cancer Research, New York). AT(11-1)-3521; AT(38-1)-595. Radiology; 107: No. 2, 429-434(May 1973).

Chronically hypoxic HeLa cells were exposed to californium and radium sources for up to 12 hr. In this system of hypoxic cells, oxygen is removed by the respiratory activity of an excess of heavily irradiated feeder cells. Using cultures with alcohol-killed feeder cells as oxygenated controls, an OER of 2.53 was obtained for radium irradiation, and an OER of 1.62 was obtained for irradiation with neutrons from californium sources. Various considerations in evaluating radiobiological factors are discussed. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 2828, 2858, and 2981.

2833 (AEC-tr-7421, pp 76-84) PRINCIPLES OF THE FORMATION OF RADIORACES IN YEAST ORGANISMS. Communication 3. Quantitative Principles of Radiation Race Formation in Diploid Yeasts. Korogodin, V. I.; Bliznik, K. M.; Kapul'tsevich, Yu. G.; Petin, V. G.; Kabakova, N. M. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 857-863(1972).

The dependence of the yield of saltants (morphologically changed colonies, growing out of irradiated cells) on the dose of irradiation, the period of appearance of colonies on the nutrient medium, and the duration of postradiation incubation in a recovery system, as well as the influence of the dose of irradiation and the period of appearance of colonies on the ratio of saltants of different groups, were studied on Saccharomyces ellipsoideus Megri-139V. It was shown that the yield of saltants in the case of irradiation at doses of the order of 70 to 80 krad may reach 65%; that the effects of delayed appearance of colonies, quite pronounced in diploid yeasts, are associated to a substantial degree with the appearance of saltant colonies with a reduced rate of growth; that damages causing the appearance of saltants are reversible. The hypothesis that radiation damages causing a lethal effect and damages leading to the formation of saltants are of the same nature is discussed. (tr-auth)

2834 (AEC-tr-7421, pp 85-95) ANALYSIS OF SURVIVAL CURVES AND RATIOS OF FORMS OF INACTIVATION OF IRRADIATED YEAST CELLS BY A PROBABILITY METHOD. Kapul'tsevich, Yu. G.; Petin, V. G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 864-872(1972).

In this work the survival curves and ratio of forms of inactivation of irradiated yeast cells are analyzed with the aid of a probability model of inactivation of the irradiated cells. The results of the calculations and the experimental data presented in the work are evidence that the probability model is suitable not only for a qualitative, but also for a quantitative description of various responses of yeast cells to irradiation; moreover, this model permits an analysis of these responses as different manifestations of the same primary radiation damages. (tr-auth)

2835 (AEC-tr-7421, pp 96-103) DECREASE IN THE SURVIVAL RATE OF BACTERIOPHAGE T1, SUBJECTED TO UV IRRADIATION AT THE EARLY STAGES OF INFECTION OF CELLS OF ESCHERICHIA COLI B. Mosin, A. F.; Tsyb, T. S.; Petrova, K. M. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 873-878(1972).

In the case of uv irradiation of phage T1 in the form of complexes with cells of E. coli B (hcr^+) at early stages of infection, the sensitivity of the bacteriophage to uv rays gradually increases as the infectious cycle develops, reaching a value close to the sensitivity of the phage irradiated in the free state and inoculated onto a layer of hcr^- bacteria. In the case of infection of cells of E. coli B_{s-1} (hcr^-), the sensitivity of bacteriophage T1 to uv rays in the early periods of infection is practically unchanged. The kinetics of the increase in the uv sensitivity of the phage in hcr^+ complexes and its dimensions do not agree with the existing concepts of a competitive (for hcr enzymes) mechanism of the decrease in phage survival in irradiated cells. It is suggested that the bulk of the host cell reactivation of the phage is accomplished during the injection of its DNA into the cell. (tr-auth)

2836 (AEC-tr-7421, pp 104-108) INTERFERON-FORMING ABILITY OF THE SPECIFIC POLYSACCHARIDE OF TYPHOID FEVER BACTERIA IN IRRADIATED AND NONIRRADIATED ANIMALS. Kamalyan, L. A.; Tumanyan, M. A.; Ter Pogosyan, R. A.; Vartevanyan, Zh. Ts.; Kheifets, Yu. B.; Duplishcheva, A. P.; Sinilova, N. G. (Ministry of Health Armenia SSR, Erevan). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 879-882(1972).

The interferon-forming ability of the specific polysaccharide of typhoid fever bacteria, which possesses a substantial radioprotective activity, was studied. The specific polysaccharide stimulated the induction of interferon in the bodies of mice, guinea pigs, and rabbits, as well as in leukocytes in vitro. Under the conditions of the irradiated organism, the specific polysaccharide of typhoid fever bacteria retained its ability to form interferon to a greater degree than virus inducers. (tr-auth)

2837 (AEC-tr-7421, pp 109-116) RADIOSENSITIVITY OF THE PROCESS OF RECOMBINATION OF GENES IN ESCHERICHIA COLI K-12. Fradkin, G. E.; Rabinkova, E. V.; Torosyan, M. V. (Inst. of Biophysics, Moscow). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 883-888(1972).

The comparative radiosensitivity of processes of recombination of genes (assembly of DNA from individual fragments) and cell division in E. coli K-12, evaluated according to the ability to form colonies, was analyzed. It is concluded that the process of recombination of genes has great radiosensitivity. (tr-auth)

2838 (AEC-tr-7421, pp 137-140) INVESTIGATION OF THE ROLE OF THIOLS IN THE DETERMINATION OF THE RADIOSENSITIVITY OF VARIOUS STRAINS OF CHLORELLA VULGARIS BEIJER. Apasheva, L. M.; Gusareva, E. V.; Kulinich, A. V.; Shevchenko, V. A. (Inst. of Developmental Biology, Moscow; Inst. of General Genetics; Moscow). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 904-906(1972).

The dependence of the radiosensitivity on the content of endogenous thiols in the cells was investigated on six strains of Chlorella vulgaris Beijer., obtained from natural populations living under conditions of chronic irradiation. The cells of an asynchronous culture of the investigated strains in the logarithmic phase of growth and a synchronous population, at the beginning of the G_1 stage, were irradiated with x rays at doses from 5 to 30 kR. The survival was recorded by the method of microcolonies. The content of total thiols in the cells was measured by the method of amperometric titration with a 0.001 M solution of mercuric chloride. A clear correlation was detected between the level of total thiols and LD_{50}; this gives a basis for believing that the endogenous thiols play a significant role in the determination of the radiosensitivity of the investigated objects. (tr-auth)

2839 (AEC-tr-7421, pp 145-148) INFLUENCE OF GAMMA RADIATION ON THE INFECTIOUS AND HEMAGGLUTINATING ACTIVITY OF CERTAIN ARBOVIRUSES. Vashkova, V. V.; Ratushkina, L. S.; Gavrilov, V. I.; L'vov, D. K.; Tumanyan, M. A. (Inst. of Virology, Moscow). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 910-912(1972).

The radiation inactivation of Japanese encephalitis virus and Venezuelan equine encephalomyelitis virus was studied. It was shown that Japanese encephalitis virus is entirely inactivated after irradiation at a dose of 6 Mrad, while Venezuelan equine encephalomyelitis virus is inactivated at a dose of 7 Mrad. The hemagglutinating activity of the viruses was retained in samples in which infectious virus was no longer detected. (tr-auth)

2840 (AEC-tr-7421, pp 181-184) INVESTIGATION OF THE RADIOBIOLOGICAL RESPONSES IN AMOEBA PROTEUS. Communication 2. Influence of the Binuclear State on the Radiosensitivity of the Amoebas. Kharlamova, L. A. (Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 934-937(1972).

The treatment of amoebas at the stage of division with a 1% solution of albumin leads to the formation of binuclear individuals. In amoebas of the resistant strain, doubling of the nuclear apparatus did not influence the survival after irradiation. Binuclear amoebas of the sensitive strain survived in a larger percentage of the cases than mononuclear amoebas. The hypothesis that the binuclear cell can give a clone after irradiation arising from a single uninjured nucleus was not confirmed: such amoebas respond to irradiation as a single organism. (tr-auth)

2841 (COO-3007-23) INTERACTION OF A BLUE-GREEN ALGAL HOST/VIRUS SYSTEM WITH IONIZING RADIATION. Kraus, M. P. (Delaware Univ., Newark. Dept. of Chemistry). 1973. 48p. Dep. NTIS $4.50.

An introduction based on a literature survey of the molecular genetics of blue-green algae is presented. More than 30 strains of the alga, Schizothrix calcicola, were isolated and culture methods are described. Properties of the viruses, LPP-1 and LPP-2, are discussed. Virus suspensions were irradiated using a ^{60}Co γ Cell 220 and then introduced into tubes containing algal culture.

Survival curves were drawn that were compared with host range and visible lysing of the inoculated cultures. Tables and graphs are presented to show results. It is concluded that the comprehension of macromolecular mechanisms of radiation resistance and the initiation of molecular genetics in a blue–green algal host/virus system can be considerably advanced by these studies. (HLW)

2842 (COO–3007-24) BLUE–GREEN ALGAL GENETICS: A NEW METHODOLOGY. Kraus, M. P. (Delaware Univ., Newark. Dept. of Chemistry). 1973. 27p. Dep. NTIS $3.50.

A new blue–green algal virus, S-3, was isolated. It appears to be a temperature cyanophage capable of defective lysogeny. A methodology is proposed for inquiring into the nature of the algal chromosome. Survival curves of a virus suspension, infecting or superinfecting various algal host cells after receiving increasing doses of ^{60}Co gamma radiation, differ in shape according to the host cells on which the irradiated virus is incubated or plated. The slopes of these survival curves appear to undergo discontinuities, which can be correlated with differences in host range and plaque type. This suggests that recombination may be taking place at chromosites or episites within the cell, which may give specific information on the state of lysogeny of a host cell. (HLW)

2843 (ORO–3857-6) MOLECULAR BIOLOGY OF REOVIRUS MULTIPLICATION. Progress Report, July 1, 1972–March 31, 1973. Joklik, W. K. (Duke Univ., Durham, N. C. Dept. of Microbiology and Immunology). 1973. Contract AT(40-1)-3857. 8p. Dep. NTIS $3.00.

Progress is reported on the following research projects: effect of chymotrypsin on reovirions; patterns of gene expression by temperature-sensitive mutants of reovirus; electrophoretic migration of hybrid RNA molecules composed of mutant plus strands and wild-type minus strands; structural polypeptide mutants; induction of interferon by temperature-sensitive mutants of reovirus, uv-irradiated reovirus, and subviral particles; amino and carboxyl terminal amino acid sequences of reovirus capsid polypeptides; preparation of reovirus top component and its effect on host DNA and protein synthesis; nature of reovirus hybrid double-stranded RNA molecules; sequencing of reovirus messenger RNAs; and mode of action and induction of interferon. (HLW)

2844 RESULTS AND PROSPECTS OF MICROBIOLOGICAL EXPERIMENTS IN OUTER SPACE. Parfenov, G. P.; Lukin, A. A. (Inst. for Medico-Biological Problems, Moscow). Space Life Sci.; 4: No. 1, 139-179(Jan 1973). (In Russian and English).

The domestic and foreign literature on microbiological studies in outer space from 1935 through 1970 is reviewed, with separate references to results obtained with balloons, high-altitude rockets and artificial earth satellites. The results of most experiments warrant the conclusion that spaceflight factors do not interfere with growth, development, cellular and nuclear division or mutagenesis in microorganisms, nor exert a modifying action on the radiation effect. In those cases when effects are observed they are as a rule attributed not to spaceflight factors but to differences in the maintenance conditions of the control and flight series of microorganisms in the period from their shipping from the laboratory till their return for study. One exception are the experiments carried out on twelve spacecraft by Zhukov-Verezhnikov and his co-workers in the U.S.S.R. and the experiment performed on Bios 2 by Mattoni in the U. S. A. These studies show that spaceflight factors appear to affect the subcellular processes in the lysogenic bacteria Escherichia coli and Salmonella typhimurium. The evidence obtained by Soviet investigators indicates that bacteria exhibit increased phage production. Mattoni's experiments show that spaceflight factors reduce or repress the phage production of lysogenic bacteria even under in-flight exposure to γ rays in doses of 265, 645 and 1640 rad. (HLW)

2845 RADIOSENSITIVITY OF RADIORESISTANT STRAIN OF PSEUDOMONAS RADIORA AND ITS RECOVERY FROM RADIATION DAMAGE. Ito, H. (Japan Atomic Energy Research Inst., Takasaki); Iizuka, H.; Okazawa, Y. Nippon Nogeikagaku Kaishi; 46: No. 3, 127-135(Mar 1972). (In Japanese).

A radioresistant bacterium, Pseudomonas radiora nov. sp., was isolated from the samples of normal rice and commercial rice. The spores of a radioresistant strain No. 0-1 were found to be radioresistant. The D_{10} value of this strain was 140 krad when irradiated in equilibrium with air, and was 60 krad under vigorous aeration. Removal of oxygen was the major cause of protection, and radioresistance of the cells decreased considerably when irradiated under vigorous aeration or in equilibrium with oxygen. Radioresistance of the cells in equilibrium with air was similar to that in equilibrium with nitrogen. The reduction of radioresistance by cyanide was also observed, which might be due to inhibition of respiration. The cells of this strain could recover rapidly from the lethal effects of gamma rays by post incubation at temperatures from 20°C to 40°C, but this recovery was partially inhibited by incubation at an optimum temperature of 30°C. Irradiated cells were able to recover at a higher rate in a minimal medium than in a nutritive medium. The effect of chloramphenicol on the inhibition of recovery of damaged cells was observed. (auth)

2846 METHODOLOGY FOR DETERMINING THE STORAGE STABILITY OF IRRADIATED FRUIT AND VEGETABLES. Vas, K. (Zentralforschungsinstitut fuer Lebensmittelindustrie, Budapest). Nahrung; 15: No. 8, 859-868(1971). (In German).

The evaluation of fruit and vegetables during storage assumes particular importance in radiation preservation. A rather work-consuming, but very informative dynamic method is described that involves as many criteria as possible. The varietal purity as well as the recording of cultivation factors, the stage of maturity, and the time elapsed between harvest and irradiation are important in storage trials. The following criteria are essential in evaluating maturation and deterioration processes: storage temperature, air humidity, stock and air movement, composition of the air, respiratory condition, consistency, microbial infection, packing, organoleptic qualities, changes permeability, and histological and chemical findings. (auth)

2847 PRESENT STATUS OF FOOD IRRADIATION IN JAPAN. National Research Program. Sato, T. (Japan Atomic Energy Research Inst., Takasaki). Proc. Jap. Conf. Radioisotop.; No. 10, 548-555(Apr 1972).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A review is presented on recent studies on the national research project of food irradiation and some related studies in Japan. As for agricultural products, the irradiation is applied for sprout inhibition of potatoes and onions, for the disinfestations of grain (rice and wheat), and for the radurizations of mandarin organes. For sprout inhibition, the irradiation with a γ ray dose of 7 to 15 krad is most suitable, and gives good results. For the disinfestation of rice and wheat, 50-krad γ ray irradiation gave no quality change during a 6-month storage after the irradiation, but the 10-krad irradiation disinfested rice weevils. Most of the rottenness of mandarin oranges is caused by green mold or by blue mold, and these molds are rather radiosensitive. The D_{10} value is 25 to 30 krad. When treated by accelerated electrons, there was not any significant change of appearance or taste up to 250 krad. As for animal products, the application of irradiation is investigated for radurization of wieners and fish paste. The consumption of wieners is the largest of all meat products in Japan. For the purpose of prolonging the preservation time of the sausage, an experiment of γ irradiation was carried out. The optimum irradiation dose was 500 krad with the ^{60}Co γ ray, and the major part of microorganisms, except only four species, were sterilized by the dose. As studies on the wholesomeness of irradiated foods, toxicological, hygienic, and chemical studies, and the studies on the effect on vitamins and on induced radioactivity in the foods were performed. Wholesomeness tests on onions and rice are in progress. Besides these practical researches, many fundamental studies were carried out in connection with radiation chemistry and radiation microbiology to extend the feasibility of the food irradiation; however, many problems remain to be overcome before the acceptance of this method as a wholesome and economical means of preserving food. (Japan)

2848 JAPANESE CHOICE OF DOSE FOR RADIATION STERILIZATION OF DISPOSABLE EQUIPMENT AND MICROBIOLOGICAL INDICATOR. Tanabe, S. (National Inst. of Hygienic Sciences, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 462-463(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Doses for the radiation sterilization of disposable medical equipment and microbiological indicators were determined experimentally. As the microbiological indicator, streptococcus faecium, Bacillum sphaericus, and B. cereus were chosen mainly because of their wide distribution in nature and high resistance against radiation. Using these three indicators, it was proved that the same sterilization effect was shown by three facilities of ^{60}Co radiation, two in Japan and one in Denmark. In cases where the extent of contamination before the sterilization is not determined, the dose required is 4 to 5 Mrad; on the other hand, when the number of contaminating bacteria is known, the dose can be calculated from the inactivation curve of the standard microbiological indicator. Experimental details were reported in another paper by the author (Radioisotopes, 20, 498–504(1971)). (Japan)

2849 ULTRAVIOLET IRRADIATION OF HERPES SIMPLEX VIRUS. Action Spectrum for the Survival of Infectivity in Relation to the Small-Plaque Effect. Cameron, K. R. (Univ. of Birmingham, Eng.). J. Gen. Virol.; 18: No. 1, 51-54(Jan 1973).

The HFEM strain of herpes simplex virus type 1 propagated in

BHK-21 cells was used to obtain an action spectrum for the survival of infectivity after irradiation by uv irradiation in relation to the small-plaque effect. Irradiation was carried out within the range 220 to 300 nm at 5 nm intervals. The initial linear region of the multi-component plaque survival curve was used to determine the 37% survival dose for each wavelength. The action spectrum obtained shows two distinct peaks at 260 and 280 nm suggesting that the survival of virus infectivity after uv irradiation is determined by uv absorption by both the nucleic acid and the protein components of the virus particles. The effect of wavelength on plaque size was also investigated, the only significant reduction in plaque size as compared with the unirradiated control being at 260 and 280 nm. (UK)

2850 INACTIVATION OF SOUTHERN BEAN MOSAIC VIRUS AND ITS RIBONUCLEIC ACID BY NITROUS ACID AND ULTRAVIOLET LIGHT. Sehgal, O. P. (Univ. of Missouri, Columbia). J. Gen. Virol.; 18: No. 1, 1-10(Jan 1973).

Upon treatment with nitrous acid, southern bean mosaic virus (SBMV) was inactivated twice as fast as its isolated RNA. Nitrous acid treatment of SBMV resulted in appreciable binding of the virus protein to the nucleic acid. The extent of deamination of aminoribonucleotides, of intraparticle RNA, and isolated SBMV-RNA by nitrous acid was identical. SBMV and SBMV-RNA were inactivated at the same rate following exposure to uv light. Furthermore, the extent of photoreactivation of the uv-irradiated SBMV and SBMV-RNA was similar. Ultraviolet irradiation did not induce any detectable binding of virus protein to RNA in SBMV. (UK)

2851 COMPARISON OF ULTRAVIOLET ACTION SPECTRA FOR VACCINIA VIRUS AND T2 BACTERIOPHAGE. Sime, E. H.; Bedson, H. S. (Univ. of Birmingham, Eng.). J. Gen. Virol.; 18: No. 1, 55-60(Jan 1973).

A number of studies made with pox viruses irradiated with uv light from germicidal lamps have revealed a curious difference in the sensitivity of different early virus functions. These unexplained differences prompted the present work of re-examining the action spectrum for the inactivation of vaccinia virus and of comparing it with that of a T-even phage, widely accepted as typical of the nucleic acid type. Inactivation curves were established for wavelengths at 5 nm intervals from 220 to 300 nm. The action spectrum for vaccinia virus obtained shows a broad peak from 255 to 275 nm while that of T2 bacteriophage has two peaks, a major one at 260 to 270 nm and a secondary one at 280 nm and a gradual rise at wavelengths below 230 nm. The action spectra are compared with those previously published for these and similar viruses. Values for absolute sensitivities of T2 bacteriophage and vaccinia virus and also the relative sensitivities of these two differ significantly from previous values. Comparisons based upon the shapes of the different action spectra show agreement with some earlier work though not with all. The inactivations at 260 and 280 nm are also examined and compared with extinction data in order to distinguish between effects in protein and nucleic acid. (UK)

2852 PHYSICAL AND CHEMICAL TESTS FOR DISPOSABLE MEDICAL PRODUCTS BY RADIOSTERILIZATION. Oba, T. (National Inst. of Hygienic Sciences, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 459-461(Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The sterilization of disposable medical products by radiation instead of ethylene oxide was investigated. This result led to the Notification of Ministry of Health and Welfare issued in December, 1970. Syringes made of polypropylene and polystyrene after an irradiation dose of 0.5 to 10 Mrad were tested after storage of 1 to 5 years for the following items: as for physical property, change of appearance and color, airtightness, hardness of rubber stoppers, compression strength of cylinders, and dropping test from 50 cm high; as for chemical property, change of pH, presence of substances reducing potassium permanganate, heavy metals, distillation residue, and silicone oil. Although the chemical tests showed little difference before and after the irradiation, the physical properties changed in some items; the syringes made of polypropylene showed color change and low compression strength by irradiation of more than 2.5 Mrad, while as for the injectors made of polystyrene, water at 4 kg/cm^2 pressure escaped by the 0.5-Mrad and more irradiation. A suture made of catgut, silk, or plastics was tested regarding its tensile strength and presence of water-soluble material. As for the disposable medical products for solution infusion, irradiation of more than 2 Mrad resulted in the formation of hydrochloric acid and the substance reducing potassium permanganate. (Japan)

2853 IMMUNITY IN EXPERIMENTAL SYPHILIS. VI. Successful Vaccination of Rabbits with Treponema Pallidum, Nichols Strain, Attenuated by γ Irradiation. Miller, J. N. (Univ. of California, Los Angeles). J. Immunol.; 110: No. 5, 1206-1215 (May 1973).

Twenty-four rabbits, each immunized intravenously over a 37-week period with a total of 3.71×10^9 γ-irradiated, non-infectious Treponema pallidum, Nichols strain, were found to be completely resistant to intradermal challenge with either 1000 or 100,000 homologous treponemes administered 10 days after the last immunizing injection. Persistence of complete immunity was demonstrable in each of 11 vaccinated rabbits challenged intradermally with 1800 T. pallidum, Nichols strain, 1 year after the last immunizing injection. In contrast, only minimal resistance was observed in 10 of the T. pallidum-immunized rabbits challenged intradermally with 1000 Treponema pertenue, Haiti B strain, 14 days after completion of immunization. Veneral Disease Research Laboratory, Treponema pallidum immobilization (TPI), and Fluorescent Treponemal Antibody-Absorbed antibodies, each of which is important in the diagnosis and control of syphilis, developed during immunization and persisted in some animals for at least 1 year. Conclusive evidence that TPI antibody is not associated with the immune response was provided by the finding that 8 of the 11 immune rabbits challenged 1 year after vaccination had no TPI antibody before challenge and failed to develop immobilizing antibody during the 3-month period of observation after challenge. (auth)

2854 CONTROL OF FOOD-POISONING BACTERIA BY IRRADIATED PEDIOCOCCUS CEREVISIAE CELLS. Al-Mashat, A. J. H. Davis, CA; Univ. of California (1972). 137p. University Microfilms Order No. 73-8306.

Thesis (Ph. D.).

P. cerevisiae, which is approved for use in fermentation of meat products, were rendered non-viable by a dose of 750 kilorad gamma irradiation. 10^9 Irradiated P. cerevisiae cells per gram of meat containing not less than 1% glucose, resulted in a decrease of pH to below 5.0 in 6-8 hours at temperatures between 22-37°C. The lowest pH we ever obtained in meat was 4.4. Cells in the final culture were harvested when the pH of the growing culture reached pH 4.3 which corresponds to the late exponential phase. The harvested cells were maintained in active condition by lyophilization in skim milk, and by freezing in phosphate buffer. The cell preparation, that was kept frozen at about -20°C before and after irradiation did not show decline in acid production capacity when tested after a period of more than a year. The rate of pH decrease caused by irradiated Pediococcus cells was approximately constant in the temperature range of 22-37°C. No detectable fermentation took place at 2°C and only small amounts of acid were formed during one week at 10°C. The effect of irradiated pediococci on strains of S. aureus, C. botulinum (A & B), Salmonella species and C. perfringens was investigated in ground beef, ham, and turkey meat to which glucose had been added. It was demonstrated that irradiated P. cerevisiae cells effectively inhibit and often kill food poisoning bacteria in semi-preserved meat containing 0-9% salt (NaCl), and with an initial pH of 6.5 or below when the meat is exposed to room temperature or higher temperature. This study has demonstrated the possibility of utilizing irradiated P. cerevisiae cells as a built-in system for control of food poisoning bacteria in processed meat products. (Diss. Abstr. Int., B)

Radiation Effects on Plants

Refer also to abstracts 2801, 2810, 2821, 2822, and 2841.

2855 (AEC-tr-7421, pp 46-51) EFFECTS OF GAMMA IRRADIATION ON THE METABOLIC ACTIVITY OF THE NUCLEAR AND RIBOSOMAL FRACTIONS OF CELLS OF THE COTTON PLANT. Ibragimov, A. P.; Plekhanova, L. S.; Gevorkyan, Zh. G.; Safarov, Sh.; Rakhmatov, N. A. (Inst. of Biochemistry, Tashkent). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 835-839 (1972).

The functional activity of nuclei and ribosomes isolated from irradiated (10 to 50 kR) cotton seedlings was investigated. In an investigation of the nuclear fraction, the effect of irradiation depended on the dose of irradiation and the age of the seedlings at the moment of irradiation (24 to 48 hrs of growth). A comparative investigation of the metabolic activity of the RNA of free ribosomes, microsomes, and polysomes showed the greater radioresistance of the RNA of the first fraction. In ribosomes isolated from irradiated plants (25 to 50 kR), a change in the fractional and amino acid composition of the ribosomal proteins was noted. (tr-auth)

2856 (AEC-tr-7421, pp 117-123) INFLUENCE OF IONIZING RADIATION ON INHIBITORS OF THE GROWTH OF VICIA FABA. Medvedev, A. L; Revina, G. L; Veselova, V. A. (Inst. of Biological Physics, Pushchino, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 889-893(1972).

The action of ionizing radiation on the content of growth inhibitors in the leaves of 12 to 15 day bean seedlings, irradiated at a

dose of 20 kR, was studied 24 hrs after irradiation. It was shown that bean seedlings contain three fractions of growth inhibitors, the content of two of which is significantly increased when the seedlings are irradiated. The isolated inhibitors are capable of acting as synergists. The influence of ionizing radiation on the regulation of plant growth and the interaction with the plant growth-inhibiting far red light are discussed. (tr-auth)

2857 (AEC-tr-7421, pp 141-144) INFLUENCE OF VARIOUS MODIFYING FACTORS ON THE THIOL LEVEL IN WHEAT SEEDS AND THEIR RADIOSENSITIVITY. Semerdzhyan, S. P.; Nor Arevyan, N. G.; Grigoryan, Z. D.; Saakyan, A. G. (Armenian Scientific Research Inst. of Agriculture, Echmiadzian). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 907-909(1972).

The influence of the degree of hydration and moisture content on the radiosensitivity of seeds of the Artashati 42 variety and the content of total SH groups in their embryo and endosperm was investigated. It was shown that with increasing time of exposure of the seeds to water (up to 48 hrs), their radiosensitivity increases, while the content of total SH groups in the embryos decreases. An analogous correlation between the radiosensitivity of the seeds and the total SH group content in the embryo and endosperm is observed in experiments where the seeds have moisture contents of 17.0, 23.6, and 28.5%. (tr-auth)

2858 (COO-3217-18) APPLICATION OF NUCLEAR ENERGY TO AGRICULTURE. Annual Report. Moh, C. C. (Inter American Inst. of Agricultural Sciences, Turrialba (Costa Rica)). 1 Apr 1973. Contract AT(11-1)-3217. 82p. Dep. NTIS $6.25.

Studies were conducted on cassava (Manihot esculenta), beans (Phaseolus vulgaris), and coffee (Coffea arabica) for plant improvement by means of induced mutations. Seeds, pollen, and stem cuttings of cassava were gamma-irradiated and mutations in leaf size, leaf shape, plant form, and growth were observed. It was found that irradiation of pollen gave the best results. The Guignard test was used for screening cassava cultivars of low hydrocyanic acid content. Field tests were conducted on mutant cassava plants for evaluating root production. Mutations were induced in beans for seed coat color changes and field tests were conducted on white bean mutants. Mutant lines of coffee plants were propagated for evaluating productivity. Studies using the sterile male technique for control of the Mediterranean fruit fly included field cage tests on mating competitiveness of medfly males gamma-irradiated during pupal or adult stages and studies on fertility and fecundity of females irradiated as pupae or adults. Studies were conducted on mating competitiveness of F_1 progeny of the coffee leaf miner (Leucoptera coffeella) obtained from males partially sterilized by gamma radiation. Effects of gamma radiation on the biology of the shootborer moth (Hypsipyla grandella) were also studied. Other studies on control of insect pests included control of the bot-fly and the shootborer moth by means of infection with Bacillus thuringiensis. Pathogenicity tests were conducted on gamma radioinduced mutants of the insect pathogen, Metarrhizium anisopliae, and effects of ultraviolet radiation on survival of B. thuringiensis were studied. Special projects included determination of the density of the seed integument of beans using Cl-36 beta rays and mass culture of Metarrhizium for field investigations. (HLW)

2859 (STI/DOC-10/141) NEUTRON IRRADIATION OF SEEDS. III. Technical Report Series No. 141. Meeting Held at Knoxville, Tn, November 17-20, 1969. International Atomic Energy Agency, Vienna (Austria)). Nov 1972. 138p. (CONF-691120-). IAEA $5.00.

From third meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969).

Separate abstracts were prepared for the 16 papers included. Abstracts of two additional papers and short communications that report on intercomparison of ionization chambers and other neutron dosimeters and methods for reduction of fungal infections in filter paper sandwiches used for seed germination are also included. (CH)

For abstracts of individual papers see: 2861 through 2876.

2860 EFFECT OF BARLEY SEED TREATMENT WITH X RAYS ON GROWTH DYNAMICS OF SEEDLINGS ROOTS AND STEMS. Maluszynski, M. (Inst. of Plant Genetics, Poznan, Poland). Bull. Acad. Pol. Sci., Ser. Sci. Biol.; 20: 91-96(1972).

By applying the growth dynamic test in respect of the root and stem it has proved possible to illustrate the growth of barley seedlings derived from seeds treated with x rays. The experiments were conducted with seeds of two barley varieties, viz. the Browarny PZHR and Frey (Hordeum vulgare L. convar. distichon L. Alef.). The seeds were irradiated at the Research Institute of Cultivated Plants, Gatersleben, GDR, and passed on to Poland. Prior to setting for germination, the seeds were soaked in water for 20 h. Throughout the 90 h of treatment, every 4 h, measurements of the increment in the first root were taken with an accuracy up to 0.01 mm. On grounds of the obtained results it was established that the earliest reduction in growth increment of roots, in x-rayed combinations, takes place only towards the end of G_2 stage of the first mitotic cycle in root cells. Making use of findings on the general somatic noxiousness, an hypothesis was framed that growth reduction in the first generation following the action of mutagenic agents is associated with disturbances evoked in the processes of transcription and translation. (auth)

2861 EFFECT OF NEUTRON IRRADIATION ON SEEDS. Gopal Ayengar, A. R.; Rao, N. S.; Bhatt, B. Y.; Mistry, K. B.; Joshua, D. C.; Thakare, R. G. (Bhabha Atomic Research Centre, Bombay). pp 1-12 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

Dosimetry studies were conducted with the standard neutron irradiation facility (SNIF) located in the pool-type reactor APSARA. At a distance of 48 cm from the core the fast-neutron and gamma-ray dose-rates were 1.19 and 0.16 rads/sec, respectively. Barley seeds (variety Himalaya 620) irradiated in SNIF and grown under recommended conditions showed increased radiosensitivity with storage time. The D_{50} values based on seedling-height reduction were 1.31 ± 0.08 krads with no storage and 1.11 ± 0.07 krads with storage. The effect of storage was followed up to 84 days at intervals of about 20 days. The frequency of chromosome deletions in stored barley seeds was lower than that in seeds without storage. With gamma irradiation, there was no storage effect in seeds after 10 days. In seeds stored for 30 days, there was a significant reduction in seedling height at higher doses and an increase of chromosome deletions with most of the doses employed. The gamma contamination, therefore, does not appear to be responsible for the storage effect noted with fast-neutron irradiation. The SNIF was used to determine the D_{50} values for 12 crop plants. RBE values were determined for them and found to vary from 6.8 to 36. RBE values have also been determined for specific mutations affecting culm length in rice. Fast neutrons are an effective means to induce variability for this character and offer the possibility of dwarf mutants with good fertilizer response. (auth)

2862 FAST-NEUTRON DOSIMETRY AND SEED IRRADIATION IN THE PHILIPPINE STANDARD NEUTRON IRRADIATION FACILITY. Soriano, J. D.; Ibe, L. D.; Claridge, M. V.; Baula, P. L. (Univ. of the Philippines, Quezon City). pp 13-16 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

Dosimetry in the SNIF located in the Philippine pool-type reactor PRR-1 was done at a reactor power of 50 and 100 kW. At the reactor power of 100 kW, where seed irradiations were made, the fast-neutron dose-rate was D_n(in CH) = 1.857 rads/sec, the neutron flux was 4.71×10^8 n/cm^2 sec and the average k-value (convention ratio) was 3.83×10^{-9}. The thermal-neutron dose was 0.234% and the gamma contribution was 10% of the fast-neutron dose in the facility. Additional gamma dose-rates of 25 rads per insertion and withdrawal of the sample drum and 6.3 rads per min, during the cooling period of the sample, were obtained. By using the standard barley seed system, it was found that 50% reduction of seedling height occurred at a dose of approximately 1120 rads of fast neutrons. The Philippine SNIF has been used to measure the effect of fast neutrons on dormant seeds of eight varieties of rice. (auth)

2863 CALIBRATION OF THE STANDARD NEUTRON IRRADIATION FACILITY IN THAILAND. Hayodom, V.; Khambanonda, P.; Saimongkol, U. (Office of Atomic Energy for Peace, Bangkok). pp 17-20 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The standard neutron irradiation facility (SNIF) was installed in the swimming-pool reactor TRR-1. From the dosimetry performed, it was found that at a reactor power of 1 MW and a distance of 63 cm from the reactor core surface to the SNIF, the neutron dose-rate was 1.32 rads/sec (in CH) and the gamma dose-rate was 0.21 rad/sec. The D_{10} values found for barley seeds irradiated in the SNIF were approximately 1.2 krads (CH) when the seedlings were grown in Thailand. When grown in Austria, the values were somewhat lower (about 1.0 krad), possibly due to a storage effect. Rhodium was studied as a threshold detector. Because the excitation or cross-section curve of rhodium resembles

the first-collision dose curve, it was felt that rhodium may be useful as a dosimeter independent of the ionization chambers. (auth)

2864 DOSIMETRIC AND RADIOBIOLOGICAL INVESTIGATIONS WITH THE STANDARD NEUTRON IRRADIATION FACILITY IN REACTOR IRT-2000. Stoilov, M.; Filev, K.; Trochev, T.; Damianov, D.; Georgiev, R. pp 21-25 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The thermal neutron flux was measured as 1.5×10^9 n/cm^2 sec by means of a cadmium-plated gold foil in the SNIF which was mounted at a 46.4-cm distance from the core of the reactor IRT-2000. The fast-neutron flux was 5.1×10^9 n/cm^2 sec when determined by standard sulphur pellets. The doses applied to seeds in the irradiation volume were determined by means of polyethylene and graphite chambers of the Greef-type. The neutron dose-rate in the working volume of the SNIF was determined as 22.2 rads/sec and the dose-rate of the gamma rays as 3.0 rads/sec, at a reactor power of 100 kW. The results obtained from measuring the size of the first leaf of the barley variety Himalaya show a linear growth reduction with increasing irradiation dose. A 50 to 55% growth reduction was observed with a dose of 1000 rads. The cytological investigations show a linear increase in the yield of chromosomal aberrations with increasing radiation dose. The data obtained with measurements of the barley seedlings show good agreement with results obtained by other authors who have used the same facility. (auth)

2865 DOSIMETRY AND THE USE OF THE STANDARD NEUTRON IRRADIATION FACILITY IN THE TSING HUA REACTOR. Cheng, C. H. (Atomic Energy Council, Taipei, Taiwan). pp 27-30 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The methods for neutron-dose measurement in the standard neutron irradiation facility located at the Tsing Hua research reactor are discussed for barley seeds as the biological dosimeter. The results are compared with those obtained by other reactor laboratories in order to obtain an accurate and reproducible set of data. The standard procedures for irradiating, cultivating, and measuring barley seeds to determine the effects of neutron irradiation are described, and the analysis of seedling-growth data is also included. (auth)

2866 COMPARATIVE BIODOSIMETRY STUDIES OF FISSION-NEUTRON FACILITIES. Smith, H. H. (Brookhaven National Lab., Upton, NY); Mikaelsen, K. pp 33-36 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The standardized biological neutron monitor based on Himalaya barley seed was compared in the fission neutron facilities of the Brookhaven National Laboratory medical reactor (Upton, New York) and the ASTRA reactor located near Vienna. The D_{50} values determined from seedling-height reduction were similar for both facilities, being 1.56 krads at the BNL reactor and 1.41 krads at the ASTRA reactor. Differences in post-irradiation storage and in growing conditions can lead to considerable variation in this parameter of neutron response and should be carefully controlled. (auth)

2867 COMPARISON OF BARLEY SEEDLING-GROWTH RESPONSE AFTER SEED IRRADIATION AT ASTRA AND HPRR. Constantin, M. J.; Conger, B. V.; Burtscher, A.; Haywood, F. F.; Brunner, H. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. pp 37-43 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

Himalaya barley seeds packaged in vacuo in Pyrex glass tubes were irradiated at Seibersdorf and Oak Ridge. After irradiation at each reactor, half of the seeds were grown at Oak Ridge and the other half were grown at Seibersdorf. Cultural conditions at the two laboratories differ which caused seedlings to grow taller at Oak Ridge than at Seibersdorf. This difference in seedling height caused by environment tended to accentuate the post-irradiation storage effects in seeds irradiated at Oak Ridge and grown at Seibersdorf, and conversely it tended to compensate for the storage effects in seeds irradiated at Seibersdorf and grown at Oak Ridge. On the basis of dose (rads, tissue-equivalent in air) there is a difference in D_{50} for seedling height of approximately 20% between the reactors. Part of this difference could be caused by a difference in the neutron-energy spectrum of the reactors. (auth)

2868 COMPARISON OF FAST-NEUTRON FLUXES IN DIFFERENT REACTORS USING THE STANDARDIZED BIOLOGICAL SYSTEM. Luse, R. A.; Brunner, H. (International Atomic Energy Agency, Vienna). pp 45-50 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, TN (17 Nov 1969). See STI/DOC-10/141; CONF-691120.

Barley seeds of the variety Himalaya CI 000620 have served as a basis for a standard biological monitor by which to estimate neutron fluxes in different reactors. Neutron doses giving 50% growth reduction (D_{50}) in barley seedlings showed excellent agreement and reproducibility in the standard neutron irradiation facilities and other neutron sources. Results are summarized for the co-ordinated program. (auth)

2869 FAST-NEUTRON IRRADIATION OF HIMALAYA BARLEY SEEDS. Effects of Packaging Material and Post-Irradiation Storage on Seedling Height. Conger, B. V.; Constantin, M. J. (Univ. of Tennessee, Oak Ridge). Contract AT(40-1)-GEN-242. pp 51-55 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The effects of different packaging material (Pyrex glass vs. polyethylene), irradiation atmosphere (air vs. in vacuo), and post-irradiation storage on the response of Himalaya barley seeds of ~13% water content to fast neutrons were investigated. Seeds irradiated in glass in vacuo showed slightly less injury as measured by seedling growth than seeds irradiated in polyethylene in air. The differences, although small, were consistent and repeatable. Seeds stored for periods up to 500 hours (three weeks) after irradiation showed substantially more injury than seeds soaked immediately. (auth)

2870 BIOLOGICAL ACTION OF INTERMEDIATE-ENERGY NEUTRONS. Hamann, H. H. (Gesellschaft fuer Strahlenforschung mbH, Munich). pp 61-65 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

Seeds of barley and Vicia faba were irradiated in the neutron field of a converter plate with various fluences and with different ratios of the fluence of fast (Φ_f) and intermediate neutrons (Φ_i). The applied ratios Φ_f/Φ_i were 0.78 and 0.31. The maximum total fluence $\Phi_i + \Phi_f$ was 90×10^{10} cm^{-2} and the maximum total dose $D_f + D_i$ was 650 rads. The fluence measurements were performed with gold, sulphur, nickel and aluminium detectors. Biological response was measured in terms of growth inhibition of the first leaf of barley and the main root of Vicia faba. From the exponential parts of the dose-effect curves, action factors k_i and k_f were obtained for the intermediate and fast neutrons, k_f is in good agreement with the action factor of 3.4 MeV neutrons. The action ratio k_i/k_f is considerably greater than the corresponding ratio of quality factors Q. (auth)

2871 EFFECT OF NEUTRON DOSE-RATE AND SPECTRUM ON THE GROWTH OF HIMALAYA BARLEY SEED. Chadwick, K. H.; Leenhouts, H. P.; Oosterheert, W. F.; Puite, K. J. (Inst. for the Application of Atomic Energy in Agriculture, Wageningen, Netherlands). pp 67-75 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

An experiment has been carried out to investigate the influence of the dose-rate and spectral shape of reactor neutrons on the growth reduction of Himalaya barley seed. There was no dose-rate effect. Different D_2O levels were used to change the shape of the neutron spectrum which was measured using threshold detectors. The results of this experiment show that a heavy-water layer of 3 cm between the reactor core and the irradiation position decreased the 50% growth-reduction dose. The values of the 50% growth-reduction dose obtained in this experiment and a subsequent gamma irradiation were greater by a factor of 1.2 to 1.4 and 1.7, respectively, than the values quoted in the literature. (auth)

2872 LACK OF UNIFORM RADIOSENSITIVITY OF DORMANT CELLS IN THE ROOT MERISTEM OF BARLEY SEEDS. A Preliminary Report. Savage, J. R. K.; Wigglesworth, D. J.

(Medical Research Council, Harwell, Eng.). pp 77-86 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

It is frequently assumed that a population of cells which have uniform radiosensitivity with respect to time exists within the dormant root meristem of seeds. If only genuine first-cycle divisions are scored it is assumed that the effects of differential delay and cell mixing produced by the radiation can be disregarded. Initial results of a series of experiments designed to test the validity of this assumption using γ-irradiated barley seed (Hordeum vulgare) are reported. Various parameters have been scored to examine the perturbations produced by radiation on the cell population, including chromosome-type aberrations at metaphase in diploid cells. The results indicate that the cells of the first-division cycle come from a heterogeneous population, and do not have a constant radiosensitivity with respect to time. (auth)

2873 CYTOLOGICAL AND GENETIC EFFECTS OF NEUTRON IRRADIATION IN DURUM WHEAT. Donini, B. (CNEN-CSN, Casaccia, Italy); Bozzini, A.; Brunori, A.; Avanzi, S.; Scarascia-Mugnozza, G. T. pp 91-94 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The cytological and genetical effects of different doses of x rays, thermal neutrons, and fast neutrons on dry seeds of two Triticum durum varieties (Cappelli and Aziziah) have been investigated. Data are reported on the relative biological efficiency of the different radiations on chromosome aberration and on morphological mutation induction. The results of chromosomal aberration analysis in root meristematic cells in the first mitotic cycle are reported. The percentage of aberrant anaphases increases with dose for all the mutagens. A higher frequency of morphological mutations per spike progeny was found after thermal and fast-neutron irradiation of seeds than after x irradiation. (CH)

2874 EFFECT OF FAST NEUTRONS AND GAMMA RAYS ON SOYBEAN SEEDLING GROWTH AND MALATE DEHYDROGENASE ISOZYME PATTERN AFTER SEED IRRADIATION. Koo, F. K. S.; Ferrer Monge, J. A.; Otero, A. M.; Bulla, L.; Alemany, A. (Puerto Rico Nuclear Center, Mayaguez). pp 95-103 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

Seedling-growth retardation and changes in isozyme pattern of malate dehydrogenase (MDH) have been employed as indices in the studies of fast neutron and γ irradiation effect on soybean seeds. Six doses (1 to 5 krads) of fast neutrons and five doses (10 to 50 krads) of γ rays were used to study seedling growth retardation. For each treatment, 30 seeds per replication with three replications were planted in the growth chamber where a constant temperature of 24°C and an illumination of 16 hr daily were kept. Periodic measurements on growth of seedling parts below and above the cotyledons were made. Growth inhibition was found to increase with increasing dose. This effect was very pronounced on the shoot growth, particularly with the γ irradiated material at higher doses. Fast neutrons appear to be more efficient than gamma rays in inducing seedling-growth retardation. Disc-electrophoresis was used to study the changes in isozyme pattern of MDH extracted from soybean seedlings grown from seeds exposed to 1.5 krads of fast neutrons or 15 krads of γ rays. Five- and twelve-day-old seedlings grown under light and in the dark were divided into five parts (roots, hypocotyl, cotyledons, epicotyl, and leaves) for the analysis. With only a few exceptions, differences in isozyme pattern were observed between the control and the irradiated material and also between the materials treated with two radiations. These changes include an increase, and only rarely a decrease, in the number of major and minor bands, the width of the bands and the staining intensity. Tissue and developmental stage specificity for isozyme pattern was also evident when the controls or the irradiated materials were compared. Light- and dark-growing conditions also caused a change in the isozyme pattern. (auth)

2875 FACILITY FOR FAST-NEUTRON IRRADIATION IN THERMAL COLUMNS. Casta, J. (Reaktorzentrum, Seibersdorf, Austria). pp 105-112 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

A standard seed irradiation facility for use in thermal columns has been constructed and tested in the thermal column of the ASTRA reactor. The facility consists of a depleted uranium block (9.7 cm × 9.7 cm × 15 cm) with a central bore 2.4 cm in diameter and with layers of boron carbide and lead at its front side. On the basis of dose-rates of fast neutrons, thermal neutrons, and gamma rays measured, the facility is well suited for seed irradiation and is similar to the SNIF with regard to its physical properties. (auth)

2876 DOSE MEASUREMENTS IN FAST-NEUTRON SEED-IRRADIATION FACILITIES AT TRIGA MARK II REACTOR IN LJUBLJANA. Najzer, M.; Pauko, M. (Univ. of Ljubljana, Yugoslavia). pp 113-114 of Neutron Irradiation of Seeds. III. Vienna; International Atomic Energy Agency (1972).

From 3rd meeting on the use of seeds as biological monitors for neutron irradiation; Knoxville, Tennessee, USA (17 Nov 1969). See STI/DOC-10/141; CONF-691120-.

The TRIGA irradiation facility (TIF) and the thermal column irradiation facility (TCIF) were installed at TRIGA MARK II reactor in Ljubljana. The properties of the facilities were determined by measurements of fast-neutron and gamma dose rates, fast- and thermal-neutron fluxes, and fast-neutron spectral indices. It was established that both facilities fulfil the requirements for fast-neutron seed irradiation. (CH)

2877 METHOD OF OBTAINING A NEW VARIETY OF CARNATION. Faye, F.; Pereau-Leroy, P. (to Commissariat a l'Energie Atomique). French Patent 2,126,614. 6 Oct 1972. Filed date 12 Feb 1971. 5p. (In French).

A new variety of Sim type carnation was developed. Mutations were produced by exposing Jacqueline variety cuttings (a naturally occurring mutant of Sim type carnations) to ionizing radiations. The cuttings were exposed to a dose of 7000 rads obtained from a ^{60}Co source. The new plant obtained, Feu Follet, possesses yellow orange flowers with bright red markings and blurred edges. The characteristics of the plant are described: growth, structure, stem, leaves and flower. (auth)

2878 TOTAL PROTEIN TO DNA RATIO IN 2C NUCLEI OF DRY SEED MERISTEMS IN RELATION TO CHROMOSOME AND CHROMATID ABERRATIONS INDUCED BY X-IRRADIATION. Ancora, G. (CNEN, Rome); Brunori, A.; Martini, G. Caryologia; 25: No. 3, 373-381(1972). (RT/BIO(72)79).

Total nuclear protein content was determined in G_1 cells (2C DNA content) of embryonic meristems in dry seeds in two groups of species: those having meristems composed exclusively of G_1 cells, which react to x rays with chromosome (B'') aberrations (Allium cepa, Heliantus annus, Pinus pinea) and those having meristems composed of both 2C (G_1) and 4C (G_2) cells in different proportions and in which part of G_1 cells react to x rays with chromatid (B') aberrations (Vicia faba, Triticum durum, Triticum dicoccum and Aegilops longissima). In species of the first group nuclear protein content in G_1 cells was rather constant, while in species of the second group a great variability of total nuclear protein content in G_1 cells was detected. The hypothesis is advanced that the protein moiety of chromosomes rather than changes in the DNA molecule may be responsible for the transition from chromosome to chromatid aberration in irradiated G_1 cells. (auth)

2879 HAPLOIDY INDUCED BY GAMMA IRRADIATION IN ARGEMONE OCHROLEUCA (2n = 56). Mary, T. N.; Malik, C. P. (Univ. of Udaipur, India). Sci. Cult. (Calcutta); 39: No. 1, 49-50(Jan 1973).

Seeds of the prickly poppy (Argemone ochroleuca) were given 10 to 30 kR of gamma radiation; one plant developing from seed exposed to 30 kR was stunted in growth and had abnormal leaves. An analysis of the chromosomes of the pollen mother cells showed a haploid condition (28 chromosomes) and a mean chiasma frequency per cell of 22.6. Germination tests showed that the pollen fertility was low. A discussion is presented of haploidy in Argemone as well as in various other plants. (HLW)

2880 ANATOMY OF MAIZE IRRADIATED WITH ^{137}Cs AND INFECTED WITH USTILAGO MAYDIS (DC) Cda. Pervova, A. Ya. Vestn. Mosk. Univ., Ser. VI, Biol. Pochvoved.; No. 3, 45-49(1972). (In Russian).

Differences in growth among normal maize sprouts, sprouts irradiated with ^{137}Cs (10 curies at 16 min), and sprouts infected with corn smut (Ustilago maydis) immediately after irradiation were compared. As compared to control plants, irradiated sprouts were shorter on the 6th day after treatment and evidenced morphological abnormalities of the leaves, roots, and shoots. Cells in the main shoot were highly vacuolated, and dividing nuclei and cells were not found. While control plants had 2 to 3 unrolled and 3 to 4 rolled leaves by the 9th day, irradiated plants had only 2 fully unrolled leaves out of 6 by the 3d week. Shoot and leaf vascular bundles

and the cambial strands also developed poorly in irradiated sprouts. Leaf parenchyma cells were hypertrophied and irregular. Starch content of irradiated sprout leaves and shoots was higher, probably due to poorer utilization for growth. Leaf stomates were irregular in shape, sometimes incomplete, and grouped together. While U. maydis stimulated mitotic activity and gall formation in normal plants, mycelial growth occurred in irradiated plants but cell division and gall formation did not. (JPRS)

Radiation Effects on Animals

Refer also to abstract 2576.

Man

2881 (BNL-17725) APPLICATION OF PROTON RADIATION THERAPY. Archambeau, J. O.; Bennett, G. W.; Levine, G. S. (Brookhaven National Lab., Upton, N. Y.). 1973. 4p. (CONF-730310-38). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Assessment of the available data indicates that proton radiation therapy has more to offer the patient than existing x ray therapy. The physical properties of proton beams which allow the major fraction of the dose to be confined to a designated volume are reviewed. Dose delivery schemes employing protons are discussed and treatment plans including dose distributions are compared for protons and x rays. (auth)

2882 (CNEA-329) DOSIMETRY AT THE HANDS DURING THE HANDLING OF ^{113m}In. de Garreta, A. C.; de Castiglia, S. G.; Feld, D.; Mitta, A. E. A. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1973. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Considering the high radiation doses received during the preparation of radiopharmaceuticals, specially the short-lived ones, due to the high initial activity used, radiation exposure to the hands of the personnel working with ^{113m}In was studied. Thermoluminescence dosimeters were placed inside the gloves so that they would not interfere with easy manipulation. Studies were done under the working conditions prevailing previously to this study, and after improvements were performed. Radiation measurements covered a whole working month and the average initial activity was 24 mCi per assay. Based on the radiation exposure values obtained, routine use of dosimeters for the hands is recommended when handling activities of such order or higher, and recommendations are given to improve working conditions. (auth)

2883 (EUR-4896(Vol.2), pp 597-625) DEPTH DOSE DUE TO NEUTRONS AS CALCULATED FOR A TISSUE PHANTOM AND MAN. Snyder, W. S.; Jones, T. D. (Oak Ridge National Lab., TN). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Some relatively new calculations of depth dose published recently by the National Council on Radiation Protection (NCRP Report n°38) are reported. Also some newer studies on slant beams and on restricted beams and sources are discussed. General remarks on dose within the body are included. (EU)

2884 (KFK-Ext.-12/72-1) PHYSICAL AND BIOLOGICAL PARAMETERS OF RADIOTHERAPY WITH MESONS, NEUTRONS, AND CHARGED PARTICLES: LET, RBE, OXYGEN EFFECT, AND DOSE FRACTIONATION. Jung, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Strahlenbiologie). Oct 1972. 45p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

A survey is given of the physical and radiobiological parameters relevant to the applicability of various kinds of radiations for tumor radiotherapy. Distributions of depth dose, linear energy transfer (LET), relative biological effectiveness (RBE), oxygen enhancement ratio (OER), and dose fractionation are discussed for x rays, γ radiation, neutrons, protons, alpha particles, nitrogen ions and pions. It is shown that negative pions should be especially favorable for the radiotherapy of deep-seated tumors. (auth)

2885 (ORNL-TM-4166) USE OF PROTON BEAMS FOR RADIOTHERAPY: A SUMMER STUDY AT ORIC. Castle, J. G. Jr.; Dickinson, R. B. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 29p. Dep. NTIS $3.50

Practicing radiotherapists have recently shown an increased interest in using the improved dose distributions available with fast proton beams. Discussions involve the criteria for and mechanics of a pilot study for cancer therapy at an existing proton facility. Dose distributions available with 65 MeV (ORIC) and with 130 MeV (Harvard-Mass. General, BNL, and NAL) are calculated and the computer printouts displayed. Reasons against using the ORIC are discussed. Use of protons with range greater than 10 cm for pilot study is planned. (auth)

2886 (ORO-4257-1) CHEST FLUOROSCOPY AND NEOPLASIA IN TUBERCULOSIS PATIENTS: A RETROSPECTIVE SURVEY. Pilot Phase. Final Report. Wood, W. B. (North Carolina Univ., Chapel Hill). 1973. Contract AT(40-1)-4257. 38p. Dep. NTIS $4.00.

Patients subjected to frequent diagnostic x-ray irradiation exposure as a result of pneumothorax or pneumoperitoneum therapy for cavitary pulmonary tuberculosis are being surveyed for incidence of neoplasia. The pilot phase of this study was conducted to determine the feasibility of locating a statistically valid number of patients or medical information concerning the patients. Effective methods of patient location were to be considered. One hundred randomly selected patients' names from admission and therapy records from North Carolina Sanatorium between the years of 1930 to 1954 were used as pilot cases. Of the total 100 patients, adequate medical history was obtained, the patient contacted, or a death certificate obtained for 90 patients; 10 patients or adequate history could not be located. Living patients contacted numbered 42, known deceased are 48. It is concluded that a sufficiently large percentage of the identified study population and controls can be located to be statistically valid. Telephone, correspondence, local health agency and bureau of vital statistics information appears to be most productive in locating patients. Questionnaire and interview of patients or family yield the most valid medical information. (auth)

2887 (TID-26323) EFFECTS OF IONIZING RADIATION ON THE TESTICULAR FUNCTION OF MAN. Ten Year Progress Report. Rowley, M. J. (Pacific Gas and Electric Co., San Francisco, Calif.). 30 Apr 1973. Contract AT(45-1)-1780. 64p. Dep. NTIS $5.25.

Data collected during a 10-year study of the effects of acute exposure to doses of x radiation ranging from 10 to 600 R on the function of the human testes are reviewed. Data are included on spermatogenesis and sperm morphology; changes in the morphology of various germinal cells and the ultrastructure of spermatogonia; individual variability in spermatogonial recovery following radiation injury; the relation of gonadotropin levels to the functional state of the testes; the relation between radioinduced depletion of germinal epithelium and levels of follicle-stimulating hormone in plasma and urine; and the effects of various radiation doses on Leydig cell function as reflected by lowered urinary testosterone levels. Cytological studies were made on tissue samples obtained by biopsy or vasectomy. (43 references.) (CH)

2888 CENTRAL RECORD KEEPING SYSTEM FOR INDIVIDUAL MONITORING. Kosaki, Nobou (Science and Tech. Agency, Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 222-224 (Apr 1972). (In Japanese).

From tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

In Japan, measurement of personal exposure and keeping of records are specified by the laws of radiation protection, labor standards, etc. In order to reduce the work load, a central record keeping system is being studied. After outlining the laws concerned, the situation overseas is described. Finally, the report made for the purpose by an ad hoc committee in the Agency is presented: items to be submitted by enterprises, personnel subject to central record keeping, processing of the records collected, standardization of the measurement of dose, and so on. (Japan)

2889 RISKS OF HEAD AND NECK SURGERY IN PREVIOUSLY IRRADIATED PATIENTS. Joseph, D. L.; Shumrick, D. L. (Univ. of Cincinnati). Arch. Otolaryngol.; 97: No. 5, 381-384(May 1973).

One hundred and five consecutive patients who underwent major surgical procedures for head and neck cancer were reviewed for complications. Those who received irradiation in an unplanned fashion suffered a far greater incidence of complications (77% dehiscence, 73% fistula, and 50% carotid artery necrosis) than did those irradiated in planned fashion (35% dehiscence, 23% fistulae, and 2.8% carotid artery necrosis), or nonirradiated patients (15% dehiscence, 8% fistulae, and 0% carotid artery necrosis). (auth)

2890 CALCULATION OF OPTIMUM TREATMENT SCHEDULES FOR FRACTIONATED HIGH-ENERGY RADIATION THERAPY. Wideroe, R. pp 397-429 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th International Betatron Symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Based on radiobiological experiments on mammalian cells, optimum treatment schedules for fractionated high-energy radiotherapy are calculated. The discussion of tumor therapy includes

the calculation of normal and tumor cell reactions, the total repopulation of normal cells, and the conversion of anoxic cells to enoxic cells. (ERB)

2891 CHANGES IN THE ^{16}O AND ^{12}O CONCENTRATIONS OF TUMOR TISSUE DURING FRACTIONATED RADIOTHERAPY. Spring, E.; Salmo, P. (Univ. of Helsinki). pp 100-102 of Second Nordic Meeting on Medical and Biological Engineering. Oslo; Norsk Forening for Bio-Medisinsk Teknikk (1972).

From proceedings of the second Nordic meeting on medical and biological engineering; Oslo, Norway (16 Jun 1971).

Radiotherapy with 33 MeV rays leads to activation in the irradiated tissues by the reactions $^{16}O(\gamma,n)^{15}O$ and $^{12}C(\gamma,n)^{11}C$. Oxygen-15 and ^{11}C decay to ^{15}N and ^{11}B emitting beta plus radiation with half lives of 2.03 min and 20.3 min. The resulting annihilation radiation can be measured after the treatment and the change in ^{16}O and ^{12}O concentrations in tumor tissue may be calculated. Results are given for four lung cancer patients. It can be seen that the ^{16}O concentration exceeds its original value in the first part of the treatment, but is lower in the second. The ^{12}C concentration increases slowly during the whole treatment. The connection between the O_2 and ^{16}O concentration is being studied. It may be practicable in the future to draw indirect conclusions from ^{12}C measurements on the O_2 concentrations and radiosensitivity of tissues. (Norway)

2892 SOME NEW ACHIEVEMENTS OF RADIOBIOLOGY AND EXPERIMENTAL HEMATOLOGY IN AEROSPACE MEDICINE. Szmigielski, S.; Kwarecki, K. (Wojskowy Instytut Medycyny Lotniczej, Warsaw). Postepy Astron.; 5: No. 1, 29-41(1972). (In Polish).

The current state of knowledge about the adverse effects of ionizing radiations on cells is reviewed, with special attention given to disturbances in cell division processes and nucleic acid synthesis. The possibility of using chemical agents that protect the organism from the adverse effects of radiant energy is evaluated, and some new experimental and clinical hematological techniques are described which can be used for precise determination of the level of radiation-induced damage and the course of marrow tissue regeneration. (IAA)

2893 EXPERIMENTAL BASIS FOR CARCINOGENIC EFFECTS OF ULTRAVIOLET RADIATION. Black, H. S. (Baylor Univ., Houston, TX). Space Life Sci.; 4: No. 1, 110-123 (Jan 1973).

It has now been demonstrated that cholesterol-derived oxidation products are formed in human skin upon exposure to ultraviolet light. One of the products formed is known to possess carcinogenic properties when administered to experimental animals. Furthermore, it has been reported by other investigators that the control mechanism for cholesterol synthesis is absent in liver tumors. Whether this biochemical lesion plays a causal role in the etiology of this disease is unknown but altered cholesterol metabolism has also been implicated in actinically induced skin cancer. It has been demonstrated in this laboratory that skin sterol synthesis is inhibited by light. The principal site of action of light on sterol synthesis appears to be prior to the formation of acetyl coenzyme A in the biosynthetic pathway. Sterol-derived photoproducts produce similar effects as light upon sterol synthesis. These observations suggest more than just a coincidental role of light upon sterols and sterol metabolism in the etiology of skin cancer. (auth)

2894 LATE RADIATION NECROSES OF THE BRAIN. Vikhert, T. M.; Lyass, F. M. (Inst. of Neurosurgery, Moscow). Med. Radiol.; 18: No. 4, 45-51(Apr 1973). (In Russian).

Pathological investigations were carried out on cerebral tissues from biopsies of patients with late brain necroses following radiotherapy of tumors of the hypophysis. The histologic picture of the necroses consisted of a grave affection of the cerebral vessels of the fibrinoid type and demyelinization of the cerebral tissue. (HLW)

2895 LOCAL RADIATION INJURIES OF AN OCCUPATIONAL NATURE. Bal'sevich, S. Ya.; Klimenko, A. A.; Karlashenko, N. I. (Moscow Scientific-Research Roentgeno-Radiological Inst.). Med. Radiol.; 18: No. 4, 51-56(Apr 1973). (In Russian).

During the period from 1955 through 1965 radiation injuries of different degrees in 37 patients (20 males and 17 females) of various occupational groups (engineers-11, roentgenologists and surgeons-14, x-ray technicians-12) were observed. The basic cause of radiation injuries was the violation of the rules of safety engineering. (auth)

2896 CLINICAL PICTURE AND TREATMENT OF FIBROSES WHICH DEVELOPED AFTER GAMMA-THERAPY IN PATIENTS WITH MALIGNANT TUMORS. Kazantseva, N. S. (Central Inst. for the Advancement of Surgery, Moscow). Med. Radiol.; 18: No. 4, 56-61(Apr 1973). (In Russian).

An analysis was made of the clinical picture and treatment of 102 patients with fibrosis of panniculus adiposus in the field of irradiation carried out with the aim of detecting various tumors, and changes in the hollow organs (intestine, urinary bladder). Radiation fibroses appeared in the form of indurative-cicatricial changes of a diffuse character of panniculus adiposus in the entire field of irradiation with a sharply marked pain syndrome and symptoms of inflammation. In the development of radiation fibroses irradiation of large fields with single and total doses exceeding tolerance of normal tissues plays an important role. A method of complex treatment of radiation fibroses including stimulation of regenerating processes in the body, control of inflammatory changes and the pain syndrome is suggested. (auth)

2897 RADIATION INJURY OF THE LUNGS AND THE SPINE IN MEGAVOLT THERAPY OF ESOPHAGUS CANCER. Tikhonov, K. B.; Rabinovich, R. M.; Shimanovskaya, K. B.; Gerasimyak, V. G.; Bakanov, Yu. L.; Dianina, E. S. (Central Scientific-Research Roentgeno-Radiological Inst., Leningrad). Med. Radiol.; 18: No. 4, 61-70(Apr 1973). (In Russian).

A clinico-roentgenological analysis was made of the condition of the lungs and the thoracic region of the spine in patients suffering from esophagus cancer and having undergone treatment with a linear accelerator with maximum energy of 4.3 MeV. Depending on the methods of irradiation and, consequently on the degree of irradiation of the organs of respiration the patients are divided into three groups: (1) 59 patients who were subjected to multiple irradiation without taking into consideration the tissue heterogeneity. In such cases radiation dose to the peripheral region of the lungs was 50 to 60 per cent of the focal dose; (2) a total of 41 patients who were treated according to the method of optimal planning without taking into consideration heterogeneity of the tissues. The doses of irradiation of the peripheral area amounted to 43 per cent of the focal dose; (3) a total of 59 patients who were irradiated according to the method of optimal planning with consideration for heterogeneity of the irradiated area. The dose of irradiation of the lungs reached 34 to 40 per cent of the focal dose. After the irradiation the percentage of radiation injuries in patients was as follows: group 1-59.3 per cent, group 2-68.3 per cent, group 3-33.9 per cent. In the latter group of patients the least number (4 out of 20) of infiltrate forms of radiation pneumonia was observed. Radiation injuries of corpus vertebrum were revealed not earlier than in a 6 month's interval following irradiation. The greatest number of destructive changes in the vertebrae was noted in the period from 6 months to 5 years after radiation treatment. Radiation pneumonia occurred in all cases of vertebral injuries. (auth)

2898 SPECIFIC FEATURES OF ACUTE RADIATION SICKNESS UNDER DIFFERENT CONDITIONS OF IRRADIATION. Gus'kova, A. K.; Ryadov, V. G.; Dibobes, I. K. Med. Radiol.; 18: No. 4, 70-78(Apr 1973). (In Russian).

Analyses were made of four mostly concrete situations causing the development of peculiar variants of radiation sickness concomitant by some additional effects of irradiation of the skin, mucosa, the thyroid gland, etc. The authors evaluate the possibility of obtaining adequate information for prognostication the incidence and severity of affections in each concrete case according to literature data. (auth)

2899 EPIDEMIOLOGY OF LEUKAEMIA. Doll, R. Seventh Annual Guest Lecture. London; Leukaemia Research Fund (1972). 50p.

It is stated that four types of leukemia are recognized for the purpose of the present report: chronic lymphatic leukemia, chronic myeloid leukemia, acute lymphatic leukemia and acute myeloid leukemia. The subject is dealt with under the following headings: age distribution; geographical distribution; temporal distribution; constitutional factors; immunological surveillance; association with other diseases (aplastic anemia and pernicious anemia); ionizing radiations; chemical leukaemogens; birth order and maternal age; infection. A list of references is included. (UK)

2900 BIOLOGICAL INDICATORS OF ACUTE RADIATION DAMAGE. Besenyo, T. Honvedorvos; 24: No. 4, 291-301(1972). (In Hungarian).

The practicability of biological radiation dosimetry is surveyed. In view of the available data it was established that the desired standard of correlation between proof of a particular substance and radiation dosage has not been attained. Further, the determination required apparatus which was impractical under field conditions and lengthy in use. The three categories of radiation sickness cannot be quickly and reliably differentiated at the present time. The development of a rapid test has been possible only in connection with disturbances in amino acid metabolism. Dependence is placed on the appearance of amino acids in the

urine only under conditions of irradiation, and may result in an approximate prognosis. (tr-auth)

2901 EXPLOITATION OF THE OXYGEN ENHANCEMENT RATIO IN CLINICAL PRACTICE. Duncan, W. (Univ. of Edinburgh). Brit. Med. Bull.; 29: No. 1, 33-38(Jan 1973).

Exploitation of the oxygen enhancement ratio in radiotherapy is reviewed in outline under the following headings: (1) Increased oxygenation of tumors, by inhalation of hyperbaric oxygen, pure oxygen, and carbon dioxide and oxygen, and by hydrogen peroxide infusion. (2) Decreased oxygenation of normal tissues by tourniquet, systemic hypoxia, and the reciprocal oxygenated anoxic method. (3) Fractionation, protraction, and dose-rate. (4) the OER in relation to radiations of high LET such as fast neutrons, π^- mesons and light atomic nuclei of C, He, Ne, Ar. (5) Agents that sensitize hypoxic cells or protect well-oxygenated ones. Mention is made here of Synkavit, and methotrexate. (UK)

2902 DEVELOPMENT OF IDEAS OF RADIOPROTECTION DURING THE LAST 50 YEARS. Recht, P. (Commission des Communautes Europeenes, Luxembourg). Bruxelles-Med.; 50: No. 11, 997-1002(Nov 1970). (In French).

The development of a preoccupation with methods of protection against radiations, the improvement of the radiographic images, and the improvement of techniques of development of radiographic film can be dated from 1920. The first period was characterized by a growing awareness of the dangers of radiation. At the end of the second period, in 1934, the ICRP set a maximum permissible dose of 0.2 rem. With the controlled fission experiment of Fermi, a new period of radiation protection was begun. In 1950, the ICRP, as a result of fatal radiation accidents in American nuclear centers and as a result of increasing knowledge, set new standards of maximum permissible doses. In 1954, for the first time, permissible levels for the population were set and the concept of a tolerance dose was abandoned. The present objectives of radioprotection are to limit the acceptable professional irradiation as an acceptable risk and to prevent accidental irradiation. (JSR)

2903 OCCUPATIONAL HEALTH ASPECT IN THE NUCLEAR ENERGY INDUSTRY. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp(Aug 1971). (In Japanese).

2904 AUTOANTITELA OBLUCHENNOGO ORGANIZMA. (Auto Antibodies of an Irradiated Organism). Ivanov, A. A.; Klemparskaya, N. N.; Mal'tsev, V. N.; Shal'nova, G. A.; Kuz'mina, T. D.; Kartashov, P. A.; Strel'nikov, V. A.; Dobronravova, N. N.; Ulanova, A. M.; Shikhodyrov, V. V. Moscow; Atomizdat (1972). 280p.

The literature data and the results of the author's own research on the peculiarities of the dynamics of the formation of autoantibodies in irradiated animals and humans subjected to x-ray therapy are discussed. An analysis is made of some new data concerning the isolation and purification of autoantibody preparations from blood serum and the tissues of internal organs of animals, and the results of experiments in which these preparations were used in the treatment of radiation sickness are cited. In addition, the new problem of the significance of the autoimmune reaction of the female organism in the occurrence of pathology in the fetus and descendants is discussed. Data concerning the determination of cells forming autoantibodies in human blood and in the blood and organs of animals are presented, as well as data concerning methods of increasing the number of such cells during the action of ionizing radiation. (IAA)

2905 SIGNIFICANCE OF THE TIME FACTOR IN THE ASSESSMENT OF RADIATION DOSES IN NUCLEAR MEDICINE. Pfannenstiel, P. (Univ., Freiburg i. B.). pp 171-176 of Frontiers of Nuclear Medicine. Horst, W. (ed.). Berlin; Springer (1971). (In German)

From assessments of radiation doses after incorporation of radionuclides, internal radiation at low dose rates appears to be significantly less effective than fractionated external irradiation at high doses of equal physical magnitude. The difference is related to the "time factor," i.e., there is more opportunity for tissue recovery during the longer irradiation period. An evaluation of 53 patients treated with ^{131}I for toxic and nontoxic goiter, thyroid cancer, and malignant lymphoma revealed that thyrotoxic patients received some three to six times greater whole-body irradiation doses than patients with nontoxic goiters or thyroid cancer. When the thyroid is overactive, the greater portion of the dose to the blood comes from the slow-release protein-bound ^{131}I phase. When an initial high dose is given in thyroid cancer therapy, an increase of reticulocytes has definitely been established. In contrast, patients receiving a low whole-body ^{131}I irradiation delivered over a longer period have shown no hematological response. In accordance with these observations, the author emphasizes the important biological aspects for dosimetry in diagnostic nuclear medicine procedures. (GE)

2906 MEASUREMENT OF RADIATION DOSES TO THE EYE LENS DURING SKULL RADIOGRAPHY, TOMOGRAPHY OF THE ORBITAL AND ITS ADJOINT REGIONS, AND DURING ANGIOGRAPHIC EXAMINATIONS. Teske, H. J. (Bochum Univ., Essen, Ger.); Schmitt, G.; Ewen, K. (Radiologe; 12: No. 12, 420-424(1972). (In German).

The measurement of radiation doses received by the crystalline lens during skull radiography is discussed. The measurements have been carried out on patients, skull specimens, and on a 3M skull phantom, using metaphosphate glass dosimeters. The most favorable radiographic voltage with regard to the protection of the eye lens was determined to be 100 kV, but it is shown that the application of diagnostically still suitable radiographic voltages of 90 or 80 kV will likewise significantly reduce the radiation dose received by the eye lens, as compared with even lower voltages. Tomograms taken with the patient lying on the back (ap ray path) will cause a radiation dose up to 50 times higher than that of tomograms taken with a pa ray path. Radiation protection by means of shielding devices proves to be impossible. For angiographic examinations including screening, protection of the eye lens of the examining physician is desirable in some cases. (GE)

2907 APPLICATION OF NUCLEAR CALCULATION METHODS TO THE PLANNING OF RADIATION TREATMENT WITH GAMMA RAYS. Hehn, G. (Univ., Stuttgart). pp 10-18 of Frontiers of Nuclear Medicine. Horst, W. (ed.). Berlin; Springer (1971). (In German).

Computer programs were developed in recent years for the design of nuclear reactors with improved shielding; these can be applied in radiology to provide a theoretical basis for earlier experimental work on radiation fields in phantoms and semi-empirical methods. The Stuttgart PLK program, originally developed to determine heat sources and equivalent doses of mixed neutron and gamma radiation, was adapted to enable calculation by computer of the production of secondary electrons by gamma radiation in the tissues. In cases where the penetration of secondary electrons can be neglected (x-ray and ^{60}Co radiation), the desired local distribution of the energy dose is found directly; where it cannot (betratron gamma radiation), the necessary information about the source of secondary electrons is obtained. Three examples are given to illustrate the efficiency of the method: a layer of homogeneous tissue, thigh, and head irradiation. Hard and soft x rays, cobalt gamma rays and betatron bremsstrahlung were programmed at energy maxima of 10, 30, and 50 MeV. (GE)

2908 EFFECTS ON POPULATIONS OF EXPOSURE TO LOW LEVELS OF IONIZING RADIATION. Report of the Advisory Committee on the Biological Effects of Ionizing Radiations. Washington, DC; National Academy of Sciences, National Research Council (1972). 228p.

A chapter on needs of the times discusses quantification of risk, cost-benefit analysis, and standards. A chapter on sources of ionizing radiation and population exposures discusses natural background radiations, medical exposures, nuclear power, nuclear explosions, nuclear ships, nuclear rocket development, and occupational exposures. Four additional chapters discuss environmental transport and effects of radionuclides, genetic effects of ionizing radiation, effects of ionizing radiation on growth and development, and somatic effects of ionizing radiation. A bibliography, glossary, and record of meetings are appended. (HLW)

2909 NEED FOR RADIATION PROTECTION. Morgan, K. Z. (Georgia Inst. of Tech., Atlanta). Radiol. Technol.; 44: No. 6, 385-395(1973).

The amount of exposure to humans through medical uses of radiation continues to be a matter of concern. Studies in the United States show that the average medical diagnostic radiation dose could be reduced by a factor of ten. One of the promising developments is the criticism by radiologists and technologists of their own standards. (auth)

2910 RADIATION EXPOSURE TO RADIOLOGISTS DURING BRONCHIAL BRUSH BIOPSIES. Sooby, D. L.; Jackson, H. L.; Sandrock, A. R.; Rich, R. D. (University Hospitals, Iowa City, IA). Radiology; 107: No. 2, 305-307(May 1973).

The radiation exposure to radiologists during a bronchial brush biopsy procedure was measured using LiF dosimetry. The average exposures to the eyes and dominant hand were 12 mR and 27 mR, respectively. No additional protective procedures or equipment were devised. (auth)

2911 LESSONS OF RADIOBIOLOGY FOR DIAGNOSTIC RADIOLOGY: CALDWELL LECTURE, 1972. Margulis, A. R.

(Univ. of California, San Francisco). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 117: No. 4, 741-756(Apr 1973).

Recommendations for reducing the x-ray dose to patients and personnel during diagnostic radiography are discussed. The recommendations include decisions on the part of the radiologist as to whether an examination is actually needed, selection of the best examination, use of the smallest number of views, and tailoring of the examination to the specific needs of the patient. (ERB)

2912 POSTIRRADIATION SARCOMA OF THE PELVIC GIRDLE FOLLOWING THERAPY FOR SQUAMOUS CELL CARCINOMA OF THE CERVIX. Fehr, P. E.; Prem, K. A. (Univ. of Minnesota, Minneapolis). Amer. J. Obstet. Gynecol.; 116: No. 2, 192-200(15 May 1973).

Four patients with postirradiation sarcoma occurring in the bony pelvis following primary irradiation therapy of squamous cell carcinoma of the cervix are reported. All of the cases occurred following orthovoltage therapy with a lag period of 9 to 23 yrs. The incidence of sarcoma in this series is approximately 650 times the rate of spontaneous osteogenic sarcoma of the bony pelvis in women. Pain antedated radiologic evidence of the tumor by 3 to 12 months in all patients. (auth)

Vertebrates

Refer also to abstracts 2817, 2818, 2836, and 2994.

2913 (AEC-tr-7421, pp 11-19) INFLUENCE OF X IRRADIATION ON THE INCORPORATION OF 2^{14}C-ACETATE INTO PHOSPHOLIPIDS AND CHOLESTEROL OF THE RAT LIVER. Vasil'ev, A. V.; Kolomiitseva, I. K. (Inst. of Biological Physics, Pushchino, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 810-815(1972).

The amount of total lipids, cholesterol, sphingomyelin, phosphatidylethanolamine and phosphatidylcholine with phosphatidylserine, as well as the incorporation of 2^{14}C-acetate into these lipids, was determined in the rat liver 24, 48, and 72 hrs after irradiation at doses of 400 and 800 R. It was shown that the amount of lipids is essentially unchanged at all periods after irradiation. The incorporation of 2^{14}C-acetate into the fractions of total lipids and cholesterol, as well as sphingomyelin, after irradiation of rats at a dose of 400 R is somewhat increased. Irradiation at a dose of 800 R sharply activates the incorporation of acetate into the total lipids, cholesterol, and phospholipids. The degree of activation differs for different lipids. (tr-auth)

2914 (AEC-tr-7421, pp 20-23) INFLUENCE OF 25-MeV BETATRON RADIATIONS ON THE ACTIVITY OF CERTAIN ENZYMES OF THE LIVER AND THE ADRENOCORTICAL SYSTEM IN RATS. Zhikhareva, A. I.; Dokshina, G. A. (Tomsk State Univ., USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 816-818(1972).

It was shown that the irradiation of rats on a 25-MeV betatron at a dose of 700 rad stimulates the adrenocortical system, as a result of which processes of gluconeogenesis are induced in the first 2 to 6 hrs after irradiation. A 2.2-fold increase in the activity of liver glucose-6-phosphatase with conservation of the glycogen reserves is observed. With the development of the radiation syndrome, the rate of processes of gluconeogenesis decreases as a result of an increase in the activity of liver phosphorylase and an inhibition of the hexokinase reaction. (tr-auth)

2915 (AEC-tr-7421, pp 58-64) INVESTIGATION OF THE DYNAMICS OF THE ACCUMULATION OF ANTIBODY-FORMING CELLS IN RATS IRRADIATED WITH A SUBLETHAL DOSE OF X RAYS. Gurvich, G. D.; Zheleznikova, G. F. (Central Roentgenoradiological Scientific Research Inst., Leningrad). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 844-848(1972).

A plasmatic reaction with an increase in the relative and absolute numbers of globulin-containing cells, detected by the immunofluorescence method, developed in the spleens of rats irradiated at a dose of 400 R, from the third to 15th days of radiation sickness. From the third to sixth days after irradiation, there was an accelerated reproduction of young forms of globulin-containing cells, characteristic of immunogenesis. Preliminary immunization of the rats with an extract of homologous spleen caused a prolonged plasmatization of the lymphoid tissues. (tr-auth)

2916 (AEC-tr-7421, pp 65-75) NEURORADIOBIOLOGICAL EFFECTS IN HEMILATERAL IRRADIATION OF THE RABBIT BRAIN. Communication 1. Dynamics of the Qualitative Changes in the Background and Induced Electrical Activity of the Cortex. Nadareishvili, K. Sh.; Bakradze, O. S.; Dashniani, M. G.; Sandodze, V. E. (Inst. of Physiology, Tbilisi, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 849-856(1972).

The dynamics of the changes in the electrocorticogram during the process of irradiation of one of the hemispheres were studied under conditions of a chronic experiment on rabbits with implanted electrodes. In the article the qualitative changes in the background and induced activity of the cortex were analyzed on the irradiated and protected hemispheres of the brain. The problem of investigation of the hemispheric interrelationships in the case of various partial irradiations of the brain as a possible prospect for the elucidation of the mechanisms of the early neuroradiobiological effects in this way is substantiated. (tr-auth)

2917 (AEC-tr-7421, pp 129-132) INFLUENCE OF IRRADIATION ON THE CONCENTRATION OF ENDOGENOUS PRECURSORS OF PROTEINS. Chagovets, E. M.; Khipko, S. A.; Likhoded, V. S.; Paskevich, I. F. (Scientific Research Inst. of Medical Radiology, Kharkov). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 898-900(1972).

The concentration and specific radioactivity of lysine and methionine aminoacyl-tRNA's of the liver and spleen of white rats, x-irradiated at a dose of 800 R, were investigated. It was established that the specific radioactivity of the amino acids studied increases in the liver and decreases in the spleen with time after irradiation. (tr-auth)

2918 (AEC-tr-7421, pp 133-136) INFLUENCE OF GALASCORBIN ON THE GLYCOGEN CONTENT IN THE LIVER TISSUE OF RATS SUBJECTED TO TOTAL IRRADIATION WITH LETHAL DOSES. Dzyubko, N. Ya. (Scientific Research Roentgenoradiological and Oncological Inst., Kiev). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 901-903(1972).

The influence of a complex preparation of vitamins C and P (galascorbin) on the glycogen content in the livers of rats irradiated totally at doses of 900 and 600 R was studied. It was shown that under the influence of radiation, the glycogen reserves in the livers of the animals are exhausted. The lowest glycogen content is observed in the period of pronounced clinical symptoms of radiation sickness. The administration of galascorbin has a favorable influence on the glycogen-forming function of the livers of the investigated animals. The effectiveness of the preparation increases with decreasing dose of irradiation. (tr-auth)

2919 (AEC-tr-7421, pp 149-154) ANTITOXIC PROPERTIES OF RADIATION CONVALESCENT SERA. Garib, F. Yu.; Krivoruchko, V. I.; Khaitova, N. M.; Garib, A. F. (Samarkand Medical Inst., USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 912-915(1972).

The purpose of the work was to investigate the kinetics of toxemia and circulation of complement-fixing antitissue autoantibodies in rabbits irradiated at a dose of 500 R. An inverse correlation was established between the increase in the titers of autoantibodies and the decrease in toxemia in the periods from the 7th to 28th days. In experiments in vitro, it was shown that during incubation (at 37°C for 2 hrs) of toxic serum of a freshly irradiated animal and serum obtained in the stage of convalescence, there is a complete exchange of toxicity. The autotoxic activity of the serum of the radiation convalescent is directly correlated with its content of circulating antitissue autoantibodies. (tr-auth)

2920 (AEC-tr-7421, pp 155-159) REACTIVE CHANGES IN THE ADRENALS OF RATS AFTER X IRRADIATION. Kimbarovskaya, E. M.; Tsareva, E. S.; El'bert, M. E.; Evseeva, L. I. (Donetsk Medical Inst., USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 916-919(1972).

A single total x irradiation of rats at a dose of 500 R induces a prolonged stress reaction, which stimulates the secretory activity of the adrenals. Changes in the nerve elements of the adrenals are expressed in a broad range from phenomena of irritation to necrosis. Daily injections of 20 mg/kg hexonium alleviate the changes described to a substantial degree. (tr-auth)

2921 (AEC-tr-7421, pp 160-164) INFLUENCE OF HYPOXIA ON THE RADIOSENSITIVITY OF MICE AND THE BEHAVIOR OF A POPULATION OF STEM CELLS, EVALUATED BY THE METHOD OF SPLEEN ENDO- AND EXOCOLONIES. Konoplyannikov, A. G.; Konoplyannikova, O. A.; Nesterenko, V. S. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 920-923(1972).

It was shown in experiments on mice of the CBA line that exposure of the animals for 7 hrs daily to a pressure of 450 mm Hg in a pressure chamber over a period of three or six days increases their survival in the case of subsequent irradiation at a dose of 800 rad. The influence of hypoxia before irradiation leads to an increased yield of spleen endocolonies and a decrease in the content of colony-forming units in a population of bone marrow cells, evaluated by the method of exocolonies on the spleen. (tr-auth)

2922 (AEC-tr-7421, pp 165-169) RADIOPROTECTIVE EFFECTIVENESS OF CYSTAMINE IN THE CASE OF ITS REPEATED ADMINISTRATION BEFORE THE INFLUENCE OF GAMMA IRRADIATION. Vasin, M. V.; Antipov, V. V. Apr 1973. Translated from Radiobiologiya; 12: No. 6, 924-927(1972).

The influence of preliminary administration of cystamine on the radioprotective properties of the preparation, administered to animals 5 to 10 min before γ irradiation, as a function of the dose of the substance and the time interval between administrations of the radioprotector, was studied in experiments on mice. The first dose of cystamine increases the radioprotective effectiveness of the subsequent second dose of the preparation in the case of time intervals between administration of the substance from 1 to 5 to 7 hrs. The degree of expression of the effect of cystamine on the radioprotective properties of the protector depends on the dose of the preparation and the time between administrations of the substance. (tr-auth)

2923 (AEC-tr-7421, pp 170-172) INFLUENCE OF TRASYLOL AND THE SOYBEAN INHIBITOR OF TRYPSIN ON THE SURVIVAL OF IRRADIATED ANIMALS. Gaponyuk, P. Ya.; Podsosov, S. P.; Rudakov, I. A. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 927-928(1972).

In experiments on Wistar rats and guinea pigs, it was shown that trasylol (50,000 KIE/kg, intraperitoneally, 15 min before irradiation) and the soybean inhibitor of trypsin (10 mg/kg, intraperitoneally, 15 min before irradiation) do not increase the survival and lifetime of animals subjected to total irradiation with the γ rays of ^{60}Co at doses of 700 and 400 R, respectively (dose rate 70 R/sec). (tr-auth)

2924 (AEC-tr-7421, pp 173-175) SENSITIVITY OF PRELIMINARILY IRRADIATED ANIMALS TO THE INFLUENCE OF TRITIUM OXIDE. Katsapov, I. S. (Inst. of Biophysics, Moscow). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 929-931 (1972).

The change in the resistance after the administration of tritium oxide (0.5 mCi/g) at various periods after preliminary external γ irradiation at a dose of 300 R was studied on noninbred female white rats. It was established that the lowest death rate of the rats was observed after the administration of tritium oxide on the 7th and 14th days after irradiation and was 40 and 33%, respectively, while when the isotope was administered 30 min after irradiation it was 64%. No correspondence was detected between the changes in weight, composition of the peripheral blood, and nature of the change in the radioresistance. (tr-auth)

2925 (AEC-tr-7421, pp 176-180) INFLUENCE OF THE HYPOTHALAMUS ON THE MOTOR ACTIVITY OF THE SMALL INTESTINE IN THE CASE OF LOCAL IRRADIATION OF THE HEAD AND ABDOMINAL REGION IN DOGS. Pochechueva, G. S. (Central Roentgenoradiological Scientific Research Inst., Leningrad). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 931-934(1972).

A disturbance of the influence of the hypothalamus on the motor activity of the small intestine after irradiation of the head and abdomen was demonstrated in a chronic experiment on dogs. The results obtained permit us to believe that a significant role in the changes in the motor hypothalamic effects noted earlier after total irradiation is played by disturbances of the higher autonomic centers. (tr-auth)

2926 (COO-1024-48) COMPARISON OF THE CYTOLOGICAL EFFECTS PRODUCED BY IONIZING RADIATIONS OF DIFFERENT LET. Technical Progress Report, March 1972–March 1973. Riley, E. F. Jr. (Iowa Univ., Iowa City. Radiation Research Lab.). 1973. Contract AT(11-1)-1024. 18p. Dep. NTIS $3.00.

Progress is reported on the following research projects: the uptake of topically applied tritiated thymidine by chick embryos; the uptake of tritiated thymidine by rat lens epithelial cells following application to the cornea; the effects of a single 200 rad dose of fission neutrons on the ability of the intermitotic cells of the rat lens epithelium to respond to wounding at one hr after irradiation and the ability of cells to recover during the first month after irradiation; and studies on wound response in rat lens epithelium following a single 1000 rad dose of x radiation to half of the epithelium. (HLW)

2927 (COO-3086-2) EFFECTS OF IONIZING RADIATION ON SALAMANDER ORIENTATION. Progress Report. Shoop, C. R. (Rhode Island Univ., Kingston. Dept. of Zoology). 1 May 1973. Contract AT(11-1)-3486. 9p. Dep. NTIS $3.00.

Field studies on the movements to and from ponds of the salamanders, Ambystoma maculatum and A. opacum, were conducted. Studies on radiation tolerances using a ^{137}Cs source showed that the tolerance of anurans was greater than that for salamanders. The LD_{50} dose for ranid frogs varied from 700 to 900 rad and that for pelobatid frogs was not achieved at doses of 200 to 3000 rad. There was an inverse correlation between liver cell DNA levels and radioresistance. Studies were conducted on effects of radiation on migration of male salamanders and effects of ^{182}Ta tagging of females on their orientations in the breeding area. Studies were also conducted on uptake and turnover of radioactive sodium, cesium, praseodymium, and europium by amphibians and reptiles. (HLW)

2928 (COO-3264-8) INBORN ANEMIAS IN MICE. Progress Report, May 1, 1972–April 30, 1973. Russell, E. S.; Bernstein, S. E. (Jackson Lab., Bar Harbor, Maine). 1 May 1973. Contract AT(11-1)-3264. 23p. Dep. NTIS $3.25.

Progress is reported on the following research projects; comparison of macrocytic anemias and delineation of inborn anemias by analysis of reactions of mice to hypoxia and x radiation; tissue localization of the internal environmental defect in anemic mice; attempts at therapy of anemia with lymphoid cells and corticosteroids; analysis of sensitivity of anemic mice to x radiation; effects of x radiation on curative power of spleen transplants; erythropoiesis in anemic and littermate normal fetuses; studies of microcytic anemia using ^{59}Fe; tissue localization of other genetic defects by intergenotype transplantation of hemopoietic tissue; hemopoietic tissue transplantation via blood transfusion; and studies on Hertwig's anemia. (HLW)

2929 (COO-3264-7) INBORN ANEMIAS IN MICE. Comprehensive Progress Report, May 1, 1970–April 30, 1973. Russell, E. S.; Bernstein, S. E. (Jackson Lab., Bar Harbor, Maine). 1 May 1973. Contract AT(11-1)-3264. 8p. Dep. NTIS $3.00.

Delineation of inborn anemias was carried out by analysis of reactions of normal and anemic mice to hypoxia and x radiation and and by other methods. A study of mutant mice with macrocytic anemia showed that there was a defect in the stem cell compartment which leads to erythroid hypoplasia after x irradiation. Mutant anemic mice were extremely radiosensitive and showed great delay in regeneration of hemopoietic tissue after whole-body irradiation. Erythropoietin levels were high in irradiated anemic mice. Progress is also reported on normal radioresistance of mutant anemic mice that were cured with implanted spleens and the curative power of x-irradiated spleens. (HLW)

2930 (RLO-2225-T-16-9) LYMPHOCYTE FORMATION, LIFE SPAN, FATE, AND POTENTIAL FOR REPOPULATING HEMOPOIETIC TISSUES OF IRRADIATED ANIMALS. Comprehensive Report, April 1, 1961–April 4, 1973. (Washington Univ., Seattle. School of Medicine). [nd]. Contract AT(45-1)-2225. 14p. Dep. NTIS $3.00.

Progress is reported on the following research projects: effects of gamma radiation on blood cells of rats with emphasis on the role of reticular cells in hematopoiesis; studies on long and short-lived populations of small lymphocytes; use of ^{3}H-thymidine in studies on formation and life span of lymphocytes; effects of antilymphocytic serum on circulation of small lymphocytes; radioinduced hypertrophy of small lymphocytes in rats; use of labeled amino acids and radioautography to assess protein synthesis in enlarged lymphocytes; effects of lethal radiation on migration of monocytoid cells in parabiotic rats; and ^{55}Fe tracer studies on effects of polycythemia on erythropoiesis in guinea pigs. (HLW)

2931 RADIOPROTECTIVE EFFECT OF RAUSCHER LEUKEMIA VIRUS IN THE SJL/J MOUSE. III. Relationship of Hematologic Factors and Splenomegaly to the Development of Radioresistance. Markoe, A. M.; Okunewick, J. P. (Allegheny General Hospital, Pittsburgh). AT(11-1)-3097. Radiat. Res.; 53: No. 3, 428-434(Mar 1973).

A study of splenomegaly and of changes in numbers of nucleated cell types circulating in the blood of Rauscher leukemia virus (RLV)-infected mice was performed and related to the recently reported pattern of development of radioresistance in these animals. Splenomegaly was first apparent as a 2-fold increase in spleen weight 10 days after RLV infection, with spleen weights increasing rapidly thereafter. The total number of circulating lymphocytes or granulocytes did not change until 18 days after infection, after which time there was a marked rise in the number of cells in both populations reaching maximum numbers that were 5-fold normal. Increased numbers of circulating nucleated erythroid cells and smudge cells were seen by the 14th day of infection. Smudge cell numbers increased by 100-fold over the next 2 weeks and nucleated erythroid cell numbers increased by 1000-fold during the same period. Thus, the Rauscher disease-induced changes in the mature blood cell population do not appear to be responsible for the early (10 day) appearance of radioresistance after RLV infection but may contribute to the maintenance of radioresistance at later times. In contrast, development of splenomegaly correlates well with the initial appearance of radioresistance, and increasing spleen size thereafter appears to be related to increasing radioresistance as the infection progresses. (auth)

2932 IN VIVO RESTITUTION OF THE DNA STRUCTURE IN GAMMA IRRADIATED RABBIT RETINAS. Wheeler, K. T.; Sheridan, R. E.; Pautler, E. L.; Lett, J. T. (Colorado State Univ., Fort Collins). Radiat. Res.; 53: No. 3, 414-427(Mar 1973).

Increasing doses of γ-radiation to the rabbit retina result in the sudden loss of the b-wave of the electroretinogram at a dose of 4300 ± 300 rads. In this same dose range, the photoreceptor cells of the retina appear to undergo an equally rapid impairment of a specific DNA repair mechanism. This impairment could result from damage to the repair mechanism itself, an accumulation of irreparable damage in the DNA, or the onset of a degradation process which overwhelms the repair mechanism. None of these alternatives can be eliminated at this time. (auth)

2933 KINETICS OF CELLULAR RECOVERY IN LOCALLY X IRRADIATED RAT ILEUM. Poulakos, L.; Osborne, J. W. (Univ. of Iowa, Iowa City). Radiat. Res.; 53: No. 3, 402-413(Mar 1973).

The onset and progression of recovery in a 2.5 cm segment of rat ileum given 1000 R x-radiation and the influence on adjacent but shielded segments were studied. The exteriorized intestinal segment was irradiated or sham-irradiated and returned to the peritoneal cavity. At 3, 5, 7, 14, 17, 21, 28, and 35 days after irradiation, the treated and control animals were given tritiated thymidine ip and killed one hour later. The irradiated or sham-irradiated segment and segments of shielded intestine 5 cm and 10 cm distal to the irradiated or sham-irradiated segments were removed and appropriately processed for histologic and autoradiographic studies. At each time sampled, the number of total cells per crypt section in both the irradiated segment and the shielded segment 5 cm distally was greater than in the respective control segments. The differences between treated and control values decreased with time after irradiation. The percent labeled cells per crypt section for samples from the irradiated area and from the segment located 5 cm distally were not different from controls. The total cells, labeled cells, and percent labeled cells per crypt section in the segment located 10 cm distally were not different from the respective control values. The results obtained indicate that local irradiation of the intestine does not change the relative size of the proliferative compartment. This is in contrast to the situation which exists after whole-body exposure to 1000 R in which the entire crypt becomes proliferative. The mucosal cell proliferation rate is slightly increased in a shielded ileal segment 5 cm from the site of local irradiation, suggesting that there is an attempt by adjacent unirradiated tissue to compensate for the temporary loss of functional crypts. The compensatory increase in cellularity in both the irradiated and shielded intestine, followed by a decrease toward control values with time after irradiation and increased distance from the irradiation site, suggests a local, temporary influence associated with changes in crypt cell proliferation. (auth)

2934 RBE OF FAST NEUTRONS FOR INHIBITION OF HATCHABILITY IN FISH EMBRYOS IRRADIATED AT DIFFERENT DEVELOPMENTAL STAGES. Hyodo-Taguchi, Y.; Etoh, H.; Egami, N. (National Inst. of Radiological Sciences, Chiba, Japan). Radiat. Res.; 53: No. 3, 385-391(Mar 1973).

Embryos of the fish, Oryzias latipes at four different developmental stages were irradiated with various doses of 2 MeV fast neutrons from a Van de Graaff or 200 kVp x rays. The hatchability, mortality, and abnormality of the irradiated embryos were examined at 25°C every day. RBE values 5.6, 6.0, 7.1, and 1.7 were obtained for median hatchability inhibition dose at the stages of cleavage, germ-ring, beginning of blood circulation, and enlargement of the tail, respectively. Data showing differences in hatching times following both kinds of radiation are also recorded. (auth)

2935 EFFECT OF X IRRADIATION ON MELANOSOMAL TYROSINASE ACTIVITY. Van Woert, M.; Korb, F. (Yale Univ., New Haven). AT(30-1)-3960. Radiat. Res.; 53: No. 3, 435-443 (Mar 1973).

The effect of in vivo and in vitro x-irradiation on melanosomal tyrosinase activity was measured in mouse B-16 melanomas. Tyrosinase activity increased from 48 to 120 hours after x-irradiation of B-16 melanomas in vivo with 1000 R, reaching a peak of 225% of control at 96 hours. In vitro, x-irradiation of melanosomes produced no change in tyrosinase activity immediately after irradiation. However, incubation of irradiated melanosomes at 4°C for 20 hours in air produced a 4 fold increase in tyrosinase activity at doses between 125 and 375 krads. In vitro, the x-ray-induced increase in tyrosinase activity was reduced by chloroquine or by incubation in nitrogen instead of air. X rays may damage the melanosomal membrane permitting an increased amount of tyrosine to reach the tyrosinase molecule within the melanosome; this mechanism could contribute to the increased tyrosinase activity produced by x-irradiation. (auth)

2936 HEMOPOIETIC RECOVERY IN POSTHYPOXIC MICE: REPOPULATION OF CFUs AND MORPHOLOGICALLY IDENTIFIABLE CELLS IN THE BONE MARROW AND SPLEEN. Beran, M. (Inst. of Radiobiology, Stockholm). Radiat. Res.; 53: No. 3, 468-479(Mar. 1973).

The repopulation of colony forming units (CFU) and morphologically identifiable hemopoietic cells was evaluated quantitatively in the bone marrow and spleen of mice exhibiting enhanced radioresistance after prolonged exposure to hypoxia. Untreated and hypertranfused mice irradiated with the same dose of 300 R served as controls. After irradiation, the immediate decrease in the number of CFUs, myeloid, erythroid, and lymphoid cells was approximately of the same magnitude in all groups of mice studied. However, in animals irradiated after hypoxic pretreatment, the recovery of CFUs and myeloid, but not lymphoid cell compartments, was accelerated. Abortive pattern of myeloid recovery seen in untreated mice was greatly improved. In spite of moderate polycythemia, the repopulation of erythroid cells in the bone marrow, but not in the spleen, was observed during the early postirradiation period. Both the absolute and the relative numbers of CFUs began to rise earlier and the normal values were reached earlier in hypoxia-pretreated than in untreated or hypertransfused mice. The physiological state did not influence the slopes of CFU repopulation, and the correlation between the magnitude of the post-irradiation dip in the CFU number and the time necessary for the recovery to normal values indicated that accelerated repopulation of CFUs was due to an earlier onset of proliferation. (auth)

2937 BACTERIAL AND HEMATOLOGICAL EVALUATION OF CATTLE EXPOSED TO LETHAL GAMMA RADIATION. Eisele, G. R.; Bell, M. C. (Univ. of Tennessee, Oak Ridge). Radiat. Res., 53: No. 3, 462-467(Mar 1973).

Hereford cattle were exposed bilaterally to 700 R of gamma radiation at 2 R/min and evaluated for bacterial and hematological alterations. These cattle had survived various radiation insults given approximately 20 months previously. Blood samples collected under sterile conditions showed bacteremia in only two animals 14 days post-irradiation. The bacteremia however was transient and could not be detected at earlier or later sampling dates. When the animals were sacrificed the irradiated group consistently yielded greater numbers and genera of bacteria from the liver, spleen, mesenteric lymph nodes, and muscle than their respective controls. Concurrent hematologic examination showed all exposed animals to have a decreased number of circulatory leukocytes, thrombocytes, lymphocytes, and neutrophils. This reduction continued to decrease with time and was not related to the incidence of bacteremia. (auth)

2938 RETENTION AND MOVEMENT OF CERIUM-141 IN THE GASTROINTESTINAL TRACT OF ADULT RATS IRRADIATED WITH 800 R AND FED GRAIN-BASED OR MILK DIETS. Sagan, C. E.; Lengemann, F. W. (New York State Veterinary Coll., Ithaca). AT(11-1)-3167. Radiat. Res.; 53: No. 3, 480-487(Mar 1973).

Mature male rats were used to determine the effect of 800 R of gamma irradiation on the retention of ^{141}Ce when the animals were either fasted, fed a commercial rat diet, or fed liquid cows milk. In addition, a study was carried out to determine the rate of transit of ^{141}Ce through the small intestine of normal and irradiated rats. Radiation slowed the transit of radiocerium through the small intestine and had a greater effect upon the stomach, upper, and midjejunum than it did on the other segments. Intestinal transit rates are presented for normal and irradiated rats. Radiation did not lead to a significant increase in permeability of the intestine for cerium. Fasting did not produce a significant uptake of radiocerium into the body but increased, somewhat, the passage of the radionuclide through the tract. Milk feeding markedly slowed the movement of radiocerium through the gut and produced some increase in the absorption of radiocerium into the body. (auth)

2939 POSTIRRADIATION PERFORMANCE OF MINIATURE PIGS AS MODIFIED BY TASKS. Chaput, R. L.; Barron, E. L. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Radiat. Res.; 53: No. 3, 392-401(Mar 1973).

The postirradiation performance of miniature pigs trained to work a shuttlebox problem was compared to that of miniature pigs trained to work a visual discrimination problem. The pigs were whole-body exposed to a gamma ray field produced by a nuclear reactor operated in the pulse mode (incident neutron to gamma ratio of 0.06) and received midline tissue doses to the brain of 1200 to 3300 rads. The major difference in performance occurred during the first 30 minutes after irradiation. At the doses used in this study, discrimination-trained pigs experienced a more severe and prolonged period of early temporary performance decrement than did the shuttlebox-trained pigs. The ED_{50} or 50 percentile midbrain dose for early performance decrement was calculated to be 1870 and 2380 rads for the discrimination-trained and shuttlebox-trained pigs, respectively. (auth)

2940 INCAPACITATION AND PERFORMANCE DECREMENT IN RATS FOLLOWING SPLIT DOSES OF FISSION SPECTRUM RADIATION. Casarett, A. P.; Comar, C. L. (New York State Veterinary Coll., Ithaca). Radiat. Res.; 53: No. 3, 455-461(Mar 1973).

Behavioral incapacitation in rats after exposure to high dose (8 to 20 krads) fission spectrum radiation was measured with a shock-avoidance jump box. An early transient incapacitation (ETI) which was consistent and dose-dependent lasted from 10 to 20 minutes after a single pulse of either 8200 or 15,300 rads. This was followed by temporary recovery, permanent incapacitation, and death. There was little or no ETI after a second pulse of 8200 rads, given 30 minutes, 60 minutes, or 24 hours after the first pulse. (auth)

2941 EFFECT OF EXCISION OR LOCAL RADIOTHERAPY TO A TUMOR AND ITS REGIONAL NODES ON METASTASES. McCredie, J. A.; Inch, W. R.; Cowie, H. C. (Univ. of Western Ontario, London). Cancer; 31: No. 4, 983-987(Apr 1973).

The incidence of lung metastases was determined following excision or local radiotherapy to the established immunologically weak syngeneic C3HBA mammary carcinoma or transplants of the syngeneic immunologically strong methylcholanthrene-induced fibrosarcoma. The tumors were grown in the hind legs of C3H/HeJ mice. The regional nodes were included in the operative specimen and in the field of radiotherapy. It was found that lung metastases were the same in mice that had the tumor-bearing leg amputated or irradiated. The treatments, therefore, did not act or had the same effect on the immune response of the host. (auth)

2942 EFFECTS OF IRRADIATION AND VITAMIN K_3 ON THE ACTIVITY OF CATALASE IN RATS BLOOD. Olinescu, R.; Cotae, M. (Spitalul Fundeni, Bucharest). Rev. Roum. Biochim.; 9: No. 2, 157-163(1972).

As the activity of catalase can be inhibited by lactic and pyruvic acids, a relationship between these parameters was studied in the blood of rats. Following the irradiation of rats there is a decrease in the activity of catalase and in the lactate/pyruvate ratio, but no evident dose dependent relationship was observed. A relationship between the activity of catalase and the lactate/pyruvate ratio was demonstrated in the erythrocytes from normal rat in the presence of vitamin K_3. In the erythrocytes from irradiated animals, the action of vitamin K_3 is changed. The vitamin K_3 injected to rats before irradiation, produces after 24 hrs significant modifications in the activity of catalase and in the lactate/pyruvate ratio but only for a high concentration of this compound 10 mg/100 g body weight. (auth)

2943 BONE TISSUE REGENERATION IN RATS AFTER TREATMENT WITH SMALL DOSES OF ^{89}Sr PRIOR TO AND AFTER DECORPORATION. Sivchev, S.; Krastonov, D. Nauch. Tr. Vissh. Med. Inst., Sofia; 49: No. 1, 1-10(1970).

It was found that intraperitoneal injection of 20 μCi of ^{89}Sr did not influence the regeneration process in bone. However, decorporation treatment influenced the differentiation and maturation of the regenerating bone. Deviations occurred in callous maturation in nondecorporated animals. Small doses of ^{89}Sr exerted a stimulating effect on the regenerate but interfered with cellular and tissue differentiation. (HLW)

2944 POST-RADIATION DIMINUTION OF CELLS IN RADIATION-RESISTANT ORGANS OF RATS AND GUINEA PIGS. Rozhdestvenskii, L. M.; Shcherbova, E. N.; Bezin, G. I. (Inst. of Biophysics, Moscow). Dokl. Akad. Nauk SSSR; 206: No. 6, 1472-1475(21 Oct 1972). (In Russian).

White rats and guinea pigs were given 700, 5000 and 10,000 R doses of γ radiation from a ^{60}Co source, and the lungs, liver, kidneys, pancreas, and the suprarenal gland were examined for a cell count during periods of time up to seven days after irradiation. The cell numbers of all organs of both types of animals decreased, with the exception of the rat suprarenals. The decrease was most notable in the lungs in rat and guinea pig. (KSW)

2945 PATHOLOGY OF RADIATION SYNDROMES IN THE HAMSTER. Eddy, H. A.; Casarett, G. W. (Univ. of Rochester, NY). Progr. Exp. Tumor Res.; 16: 98-119(1972). (UR-49-1364).

The Syrian and Chinese hamster strains have been found to be among the most radioresistant mammals yet studied, with respect to lethality and survival time after irradiation. Measurement of recovery of the hamster in terms of split-dose lethality technique reveals a biphasic pattern during the first few weeks post-irradiation which has been observed in only a few other species (and these of much larger size). Histopathologic study of tissues from irradiated hamsters suggests that the degree of radioresistance, and perhaps the pattern of recovery, may be related to the proliferative capacities of specific organ systems. The median lethal exposure of $LD_{50/30}$ causing death primarily as a result of damage to the blood-forming organs (hemopoietic syndrome) in the hamster is about 900-1000 R, as compared with lesser exposures, down to a few hundred R, for other species. The bone marrow of hamsters after such exposure shows early regenerative activity leading to marked hyperplasia of primitive stem cells to a degree not observed in many other species. With higher exposure levels causing death primarily as a result of damage to the gastrointestinal system (usually in the range of 1,000 to 8,000 R or more for various species), an 8-day period in which to measure the LD_{50} better describes the development of the syndrome in hamsters, rather than the 5-day period used for many other species. The principal differences observed in the hamster, as compared with many other species, are the longer maintenance of an intact intestinal epithelial lining and a more vigorous regeneration of epithelial cells after exposure. Even with exposures higher than 8,000 to 10,000 R, which result in early death primarily due to central nervous system damage, survival times in the hamster are longer after given exposure than in most other species. Limited histopathologic data for this syndrome in hamsters prevent comparisons with other species at the present time. (auth)

2946 EFFECT OF CYSTEINE ON HAEMATOPOIETIC TISSUES. Kovacs, P.; Hernadi, F.; Dezsi, Z. (Univ., Debrecen, Hungary). Acta Biochim. Biophys. (Budapest); 7: No. 1, 67-74 (1972).

Four days after a single intraperitoneal injection of 1000 mg/kg L-cysteine-HCl $\cdot H_2O$, the number of spleen colony-forming units (CFU) was reduced in the femoral marrow of BALB/c mice. The number of CFU in spleen was decreased two days after the administration of cysteine, and showed an increase on the fourth day. Incorporation of thymidine-2-^{14}C into bone marrow DNA in vivo was reduced when administered 30 minutes, 6 hours, 4, 8 or 10 days after cysteine. These alterations in haematopoietic tissues were not accompanied by changes in the radioresistance of the whole mice ($LD_{50/30}$ of ^{60}Co gamma rays) except 30 minutes after the administration of cysteine. The finding that the incorporation of labeled thymidine into bone marrow DNA is inhibited by cysteine administered 30 minutes earlier is interpreted as an inhibitory effect of cysteine on cells in the S-phase. This delay in DNA synthesis may facilitate DNA repair and, thus contribute to the radioprotection afforded by cysteine to the whole animal. (auth)

2947 MATERNAL X-IRRADIATION EFFECTS ON FECUNDITY AND MORTALITY IN PROGENY. Batra, B. K.; D'Souza, A. V.; Palayoor, S. T. (Cancer Research Inst., Bombay). Indian J. Med. Res.; 60: No. 2, 208-217(1972).

Fecundity and mortality in 25 generations of the C_{57} Bl/Icrc mice irradiated at 300 R at maturity were investigated. Sex ratio was unaltered. Litter size was not considerably reduced. However, the fertile period was significantly reduced. This, in addition to the increased late neonatal mortality resulted in ultimate termination of the x-irradiated progeny. (Indian Science Abstracts)

2948 ROLE OF THE THYMUS IN THE REGENERATION OF THE CERVICAL LYMPH NODES IN TOTALLY AND PARTIALLY IRRADIATED MICE. Gibertini, G.; Catalini, N.; Filoni, S. (Univ., Rome). Acta Embryol. Exp.; 1: 107-121(1972).

The influence of the thymus in the regenerative processes of the cervical lymph nodes, both in totally irradiated mice and in partially irradiated mice with screening of the thymus was studied. In the lymph nodes of the mice irradiated with shielding of the thymus, the percentage of picnotic lymphocytes found was lower than in the totally irradiated mice and the mitotic index was considerably higher. A correspondingly high mitotic index was also found in the screened thymuses. It was concluded that there is a continuous migration of the thymocytes in the direction of the cervical lymph nodes damaged by the x-rays. (auth)

2949 24-HOUR RHYTHM OF PROTEIN METABOLISM IN HEPATOCYTES AND EPITHELIAL CELLS OF RAT SKIN IN ACUTE RADIATION SICKNESS. Bulgak, V. I.; Chekulaeva, L. I. (Inst. of Experimental Medicine, Leningrad). Byull. Eksp. Biol. Med.; 74: No. 10, 42-44(Oct 1972). (In Russian).

A method of autoradiography with the use of methionine-^{35}S was applied to the study of 24-hour rhythms of protein metabolism in hepatocytes and epidermis of the paws of albino rats in acute radiation sickness. (auth)

2950 EFFECTS OF COMBINED RADIATION PROTECTION AGENTS IN ANIMAL RESEARCH. Santha, A.; Sztanyik, L.; Mandi, E. Honvedorvos; 24: No. 4, 279-289(1972). (In Hungarian).

Radiation protection effects and the toxicity of a combination of AET with 5-MOT(mexamine) of CySH(cystine) were investigated in mice that had been irradiated with 800 to 1600 R of

x radiation. A synergistic protective effect was found with certain combinations without side effects or an increase in toxicity. (tr-auth)

2951 MECHANISM OF ACTION OF IONIZING RADIATION THROUGH STUDIES ON SKIN PROTEIN METABOLISM. van der Schueren, E. (Catholic Univ., Louvain, Belgium). Verh. Kon. Vlaam. Acad. Geneesk. Belg.; 32: No. 5, 335-450(1970). (In Dutch).

Studies were conducted on protein metabolism of the skin of male Wistar rats and hairless mice. Cyclic acceleration of glycine-2-^{14}C incorporation followed by return to initial levels was observed. The variations were particularly distinct in young animals and progressively decreased with age. Free amino acids increased in the skin at the beginning of the cycle and a sudden decrease then occurred. After exposure to ionizing radiation the most consistent effect was inhibition of glycine incorporation into proteins, but in certain cases stimulation was found. High radiation doses increased the concentration of free amino acids and low doses decreased it. (HLW)

2952 EFFECT OF PENETRATING RADIATION ON THE COMPOSITION OF PERIPHERAL BLOOD IN RATS AT HIGH ALTITUDES. Sharipov, F. Kh. (Tadzhik State Medical Inst., USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 12, 53-55(1972). (In Russian).

White male rats were given doses of x rays at low altitudes (800m) and at high altitudes (3370 m), and erythrocytes, reticulocytes, hemoglobin, thrombocytes, leucocytes and other components of the peripheral blood were studied from one to 30 days after irradiation. The changes in the composition of the blood of the two groups of rats were similar, but were more pronounced in the case of the high-altitude group. (KSW)

2953 RADIOPROTECTIVE EFFECT OF GROUNDNUT OIL. Korgaonkar, K. S.; Ghanekar, S. P. (CRI, Bombay). Indian J. Biochem. Biophys.; 9: No. 1, 116-118(1972).

Subcutaneous injections of groundnut oil showed 10 to 20% reduction in the lethality of rats exposed to whole-body single dose (900 to 1100 rad) of gamma irradiation. Treatment with this oil also gave marked protection to skin in local irradiation with 220 and 70 kV x rays in rabbits as well as cancer patients. (Indian Sci. Abstr.)

2954 PHARMACOLOGY OF BARBITURATES IN MONKEYS (MACACA MULATTA) EXPOSED TO GAMMA-NEUTRON RADIATIONS. Davis, L. W.; Brown, J. A.; Strike, T. A. (Defense Atomic Support Agency, Bethesda, MD). Res. Commun. Chem. Pathol. Pharmacol.; 2: No. 4-5, 447-460(1971).

The plasma disappearance half-time of barbital, hexobarbital, and pentobarbital, and the plasma and cerebrospinal fluid disappearance half-times of pentobarbital-^{14}C were determined in monkeys. These half-time values were compared to the ones obtained after the monkeys received 1500-, 5000-, or 10,000-rad doses of mixed gamma-neutron radiations to the entire body. In general, a radiation dose dependent increase of plasma disappearance half-times for all drugs was evident with a significant increase for barbital after 5000 rads ($P < .001$) and hexobarbital after 10,000 rads ($P < .05$). Cerebrospinal fluid disappearance half-time of pentobarbital was significantly prolonged in the monkeys receiving 5000 rads. These results are interpreted as indicating that increased barbiturate effectiveness is related to decreased renal excretion of the drug, decreased drug metabolism by liver enzymes, and increased drug concentration in the central nervous system. (auth)

2955 IMPAIRMENT OF RAT HEPATIC MICROSOMAL DEMETHYLATING ACTIVITY AND STRUCTURAL PROTEIN AFTER X IRRADIATION OF THE HEAD. Kvasnichova, E.; Lejsek, K.; Hais, I. M. (Charles Univ., Hradec Kralove, Czech.). Biochem. Pharmacol.; 22: No. 2, 275-277(15 Jan 1973).

The effect of irradiating the heads of rats, while their bodies were shielded, with 1000 R x irradiation was studied. The electrophoretic patterns of the liver microsomal protein with the pethidine-demethylating activity, total microsomal protein, and cytochrome P-450 level were studied to elucidate the decrease of pethidine-demethylating activity in isolated rat liver microsomes previously observed by the authors (Experientia; 27: 130 (1971)) and the disappearance of two components from the isolated microsomal structural protein also previously observed by the authors (Biochim. Biophys. Acta.; 221: 680 (1970)) after whole-body x irradiation. From the results it is concluded that these effects are not due to direct impairment of liver endoplasmic reticulum by radiation. (UK)

2956 COMPOUND FOR ALLEVIATING RADIATION INJURY AND PROCESS FOR PREPARATION THEREOF. Sekiguchi, T.; Fujii, T.; Kobayashi, H. (to Kakenyaku Kako Kabushiki Kaisha). British Patent 1,305,114. 31 Jan 1973. Filed date 16 Jun 1970. 6p.

Radioprotective compounds are known that are able to react with radiation induced free radicals formed in the human body by ionizing radiation, but such compounds are ordinarily effective only when administered prior to irradiation. There are very few compounds (restoratives) that can alleviate radiation injury when administered after irradiation, and there is a particular need for a restorative to alleviate the severe side effects accompanying irradiation treatment of cancer with x rays of ^{60}Co γ rays. Deoxyribonucleic acid biosynthesis is severely inhibited in mammals by ionizing radiation and scarcely any substances are known that are capable of restoring DNA biosynthesis subsequent to irradiation. It has, however, been confirmed that high molecular weight DNA is effective in alleviating radiation injury in animals if isolated from the same species. It is difficult, however, to apply this finding to human beings, since it is difficult to obtain suitable human tissue materials as a DNA source, and furthermore the use of very high molecular weight heterologous DNA might involve the possibility of hereditary danger for human beings. Based on these and other findings it was presumed that the administration of synthetic compounds of DNA combined with antigenetically safe basic polyamines or polyamino acids, resembling the natural complex compound of DNA and histone, present in higher animals, would be more effective than DNA alone against radiation injury, and the synthesis of such compounds, of molecular weight >200,000, is described, together with tests on mice. Non-human DNA was employed in the synthesis, including that from fish sperm or animal organs. (UK)

2957 THEORY OF RADIATION DOSE-SURVIVAL CURVES FOR THE CASE WHERE ORGANISM LETHALITY IS DEFINED AS LOSS OF REPRODUCTIVE CAPACITY. 2. Application to Cells and Physical Interpretation. Craig, A. G. (Univ. of Salford, Eng.). J. Theor. Biol.; 38: No. 1, 81-99(Jan 1973).

The general theory of survival curves (Craig 1971) is applied to the case of cells and sub-cellular organisms with a physical interpretation via gene or chromosome damage as the terminal lesion. It is indicated how the proposed terminal lesion is consistent with the salient features of cellular response to radiation and analytical expressions for reactivity and sensitivity in terms of a damage, or mutation, cross section are obtained. The probability of a complex cross section and conditions under which it reduces to simple approximations are discussed and the influence of various factors on the cross section are indicated. Acceptable fits are obtained to the data of Barendsen, Beusker, Vergroesen, and Budke (Radiat. Res.; 13: 841(1960)), McCulloch and Till (Radiat. Res.; 16: 822(1962)), and Puck and Marcus (J. Exp. Med.; 103: 653(1956)) with simple forms of cross section. (auth)

2958 MECHANISM OF INTESTINAL RADIOSENSITIZATION BY ACTINOMYCIN D. Hagemann R. F.; Concannon, J. P. (Allegheny General Hospital, Pittsburgh). Brit. J. Radiol.; 46: No. 544, 302-308(Apr 1973).

The interaction between actinomycin D (Act D) and x irradiation on the mouse jejunum was examined. The two principal actions of the drug were to: inhibit repair of sublethal radiation damage as evidenced by a reduction in shoulder width of the crypt survival curve and by lack of repair between divided exposures; and delay the onset of the compensatory hyperplasia that characteristically occurs following irradiation. Due to the latter, a larger number of surviving crypts was required to provide levels of functional epithelium compatible with animal survival. In experiments employing hydroxyurea to partially synchronize the proliferative compartment, it was found that cells in the G_1 phase of the cell cycle were most sensitive to Act D. It was also noted that the majority of crypt cells, exposed to relatively high doses of Act D, were able to ascend the villus. Similar results were obtained with x irradiation. An interaction between x irradiation and Act D could be detected when the radiation was delivered as long as five days after the drug. (auth)

2959 ACTION OF VERY SMALL DOSES OF RADIATIONS ON CERTAIN ENZYMES IN RANA ESCULENTA. Pora, E. A.; Manciulea, St. 24: No. 2, 139-142(1972). (In Rumanian).

Irradiation with a total dose of 512 m applied as a unique or fractionated dose, induced a decrease in the activity of cytochrome oxidase and succinate dehydrogenase of the liver of frog. The same treatment did not affect the activity neither of glutomic-pyruvic transaminase nor of glutamic-oxalacetic transaminase. (Rom. Sci. Abstr.)

2960 HISTOLOGICAL CHANGES IN TESTES OF THE GARDEN LIZARD, CALOTES VERSICOLOR (DAUDIN), FOLLOWING X-IRRADIATION. Ghosh, A.; Maity, L. K.; Banerjee, S. K. (Kalyani Univ., West Bengal, India). Indian J. Exp. Biol.; 10: No. 6, 459-461(Nov 1972).

Histological changes in the testes of C. versicolor were studied at various periods up to 14 days, following whole-body x-irradiation with 450 R. X-irradiation impaired spermatogenesis and induced histological changes in the seminiferous tubule. Leydig

cells as well as Sertoli cells were radioresistant, while spermatogonia, spermatocytes and spermatids revealed gradual degenerative changes. Spermatogonia appeared to be the most sensitive cell type, and their gradual reduction in number was possibly due to mitotic inhibition in them. (auth)

2961 CHANGES IN THE SPLEEN CAUSED BY EXPERIMENTAL FRACTIONATED LOCAL X IRRADIATION. Kovacs, L. (Radiology Clinic, Budapest). Acta Morphol. Acad. Sci. Hung.; 20: No. 1-2, 1-12(1972).

The spleens of rats were subjected to percutaneous x-irradiation in 16 fractions, with a total of 8000 R. The changes were studied by histological and histochemical methods 1, 3, 5, 7, 10, 15, 50, 100, and 150 days after the last irradiation. According to the results obtained, the alterations can be divided into 3 periods. During the first period (1 to 3 days) lymphocytes were not detectable in the organ, only reticular cells containing large amount of haemosiderin show an increased activity. In the second period (5 to 15 days) regeneration of the lymphocytes starts from the reticular cells and from the circulation. In the third period hyperplasia of the connective tissue and damage to the vessel walls, increasing slowly up to the 150th day, led to a gradual decrease of the number of lymphocytes. No pathological alteration could be found in the reticular cells. (auth)

2962 INFLUENCE OF X RAYS ON MYOCARDIAL METABOLISM AND ELECTROLYTE DISORDERS. Part 1. Radioinduced Changes of Calcium Content in Isolated Guinea Pig Auricles. Prignitz, R.; Hoffmeister, G. (Univ., Marburg, Ger.). Strahlentherapie; 145: No. 2, 207-215(1973). (In German).

The behavior of cellular calcium was studied in isolated resting and electrically stimulated guinea pig left auricles. After irradiation with 1000, 6000, and 10,000 R, the uptake and loss of ^{45}Ca during the test period were significantly augmented, the specific activity (Imp/min/0.1 μeq Ca), however, only initially. Another consequence of the irradiation was a significant increase of the calcium concentration in the myocardial tissue. The results are discussed in connection with radioinduced electrolyte shiftings and metabolic changes described in the literature. (GE)

2963 RADIATION-PROTECTIVE PROPERTIES AND THE MODE OF ACTION OF FENCHLORFOS. Panek, R.; Wisniewski, K.; Sarosiek, W.; Daniluk, J.; Szymanski, A. (Akademia Medyczna, Bialystok, Poland). Strahlentherapie; 145: No. 2, 187-196 (1973). (In German).

In preceding experiments it was found that Trichlorfon, a phospho-organic compound, exerts a strong radiation-protective effect with respect to the survival rate. It was also demonstrated that the mode of its action is based on certain metabolic processes and not on the inhibition of the acetylcholinesterase (AChE) activity. The radio-protective properties of Fenchlorfos, another compound with a somewhat different structure, were investigated and its influence on several metabolic parameters, important for the mode of radiation-protective action of this compound, was studied. The experiments were performed on 420 Wistar rats. Fenchlorfos was perorally administered by feeding tube, in a suspension of arabic gum and in doses of $1/20$, $1/5$, and $1/2$ LD_{50}. This compound exerted a significant radiation-protective effect with regard to the survival rate (DRF = 1.42), but caused an increase of the radioinduced toxemia (O-quinone level and lipoid-peroxide level in the rat liver). Fenchlorfos also caused an increase of cathepsin activity; but when it was applied before irradiation, it prevented this increase. Moreover, a radiation-protective dose of Fenchlorfos caused alterations of the energetic cytochemistry: it increased the lactic acid level without altering the pyruvic acid level in the liver parenchyma. It also influenced the enzymes of the respiratory cycle, as it caused an increase of the activity of the cytochrome oxidase, not influencing the activity of the succinic acid dehydrogenase. Based on these results, the following conclusions were made: Fenchlorfos exerts a strong radiation-protective effect; in the mode of its action the influence on various metabolic processes, mainly on energetic cytochemical processes, plays an important role. These changes could be understood as "biochemical cell shock." (GF)

2964 ACTIVATION OF ACID PHOSPHATASES IN GLIA CELLS OF THE RAT BRAIN DURING THE POSTNATAL PERIOD AFTER SINGLE AND FRACTIONATED X IRRADIATION. Arnold, V.; Lierse, W.; Franke, H. D. (Univ., Hamburg). Strahlentherapie; 145: No. 3, 317-324(1973). (In German).

Thirty-two rats were irradiated with 200 kV x rays on their heads, the rest of the body being covered. One group got homogeneous single irradiation with 500 R on the 10th day of life, the other group got fractionated irradiations with 500 R on the 10th day, and with 500, 750, or 1000 R on the 13th day of life. After 1 to 15 days, acid phosphatases were histochemically demonstrated in the glia cells. Single homogeneous irradiation caused a dose-dependent and regionally different activation before the beginning of the phase of increasing enzymes. The glia of the diencephalic centres, the fastigial nuclei in the vermis of the cerebellum, and the hippocampus are less sensitive than the glia of the corpus callosum and the cortical marrow in the cerebellum. Following activation a recovery phase begins, in which the reaction of the acid phosphatases strongly decreases. After fractionated x-ray irradiation the activation is lower than after single irradiation-independent of the dose. The recovery phase is delayed. (GF)

2965 REGIONAL LYMPH NODE IRRADIATION: EFFECT ON LOCAL AND DISTANT GENERATION OF ANTIBODY FORMING CELLS. Weissman, I. L.; Peacock, M.; Eltringham, J. R. (Stanford Univ., CA). J. Immunol.; 110: No. 5, 1300-1306(May 1973).

After footpad injection of sheep erythrocytes into Fisher rats, the major site of appearance of direct and indirect antibody plaque forming cells (direct and indirect) is the regional lymph node. Indirect plaque forming cells are subsequently found in the spleen, but no other lymphoid tissues. Repeated irradiation (days 1, 3, 5, 7, and 9) to the draining lymph node region after antigenic stimulation prevents the appearance of plaque forming cells in the spleen by day 10. Selective irradiation of this node group on days 4 and 5 prevents splenic appearance of indirect plaque forming cells only, whereas contralateral node irradiation does not. Irradiation at a later time (days 7 and 8) did not significantly lower the level of splenic indirect plaque forming cells by day 10. We concluded from these experiments that the appearance of splenic indirect plaque forming cells was dependent on radiosensitive cell populations in the antigen draining lymph nodes, and not on the generation of these cells independently in the spleen. (auth)

2966 UNILATERAL REDUCTION OF OVULATIONS FOLLOWING SELECTIVE OVARIAN X IRRADIATION. Hahn, E. W.; Feingold, S. M. (Memorial Sloan-Kettering Cancer Center, New York). Endocrinology; 92: No. 5, 1447-1450(May 1973).

Exposure to 200 or 400 R of one ovary in situ in the rat given 4 to 6 days prior to mating, significantly decreased the number of ova shed. The contralateral unirradiated ovary responded with a compensatory number of ovulations. Exposure on the second or third day prior to mating did not effect such a shift. Data on implantations and term litter size are also included. Possible mechanisms of action are discussed. (auth)

Invertebrates

Refer also to abstract 2858.

2967 (CSIRO-Trans-11266) EFFECT OF IONIZING RADIATION ON THE THEILERIA ANNULATA WITHIN TICKS. Barannikov, V. D. Translated by M. Prazak from Tr. Vses. Inst. Eksp. Vet.; 38: 70-72(1970). 4p. Dep. NTIS (U. S. Sales Only) $3.00.

Hyalomma anatolicum ticks parasitized by Th. annulata and exposed to doses of 3,000 and 4,000 rad were used to infect heifers. These animals contracted theileriosis from 3 to 5 d later than controls. The experimental animals showed the highest parasitaemia and the sickness had a more severe course in the heifer on which ticks exposed to 4,000 rad were fed. (Australia)

2968 GAMMA RADIATION SENSITIVITY OF MALATHION-RESISTANT STRAINS OF THE INDIAN MEAL MOTH. Brower, J. H. (Agricultural Research Service, Savannah). J. Econ. Entomol.; 66: No. 2, 461-462(Apr 1973).

Tests were made of the relative gamma-radiation sensitivity of 2 malathion-resistant strains of Plodia interpunctella (Hübner). Pairs of moths from each strain were irradiated with 5 krad, and their fecundity was compared with that of nonirradiated pairs. No significant difference ($P = 0.05$) was noted between the number of progeny produced by the nonirradiated malathion-resistant strains and the nonresistant normal control strain. The radiation exposure significantly reduced the number of progeny for each strain but no significant difference ($P = 0.05$) was noted in the number of progeny for the 3 strains after irradiation. (auth)

2969 CELLULAR RESPIRATION IN ONTOGENY OF THE SILK GLAND IN BOMBYX MORI UNDER THE INFLUENCE OF MICRODOSES OF γ AND uv IRRADIATIONS. Fioca, L. ; Pora, E. A. St. Cerc. Biol. Zool.; 24: No. 2, 125-137(1972). (In Rumanian).

The two silk glands show a proper cell respiration type, characteristic of the 4th larval stage as well as of the 5th one. Ultraviolet irradiations and γ microdoses induce oxygen uptake diminution in both gland regions of the 4th larval stage. Fibrionic region cells are more sensitive towards the physical factors used than the sericinic region cells of the silk gland. It is concluded that the response to the uv irradiations and γ

microdoses of the silk gland cells is specific to each gland region and dependent upon the cells physiologic state and upon their metabolic activity during the irradiation, respectively. (Rom. Sci. Abstr.)

2970 PREFERTILIZATION STIMULATION OF SEA URCHIN EGGS CAN CURE RADIATION-INDUCED MITOTIC DELAY. Rustad, R. C.; Greenberg, M. A. (Case Western Reserve Univ., Cleveland). Exp. Cell Res.; 75: 285-288(Nov 1972).

Mitotic delay resulting from γ-radiation damage to sea urchin sperm can be reduced, and in some cases eliminated, if the eggs are stimulated before fertilization with a dye or a detergent. This "cure" for radiation-induced mitotic delay may be a consequence of an enhanced synthesis of proteins required for the recovery from the radiation damage and/or for normal mitosis. (auth)

2971 LOW-DOSAGE GAMMA RADIATION EFFECTS ON THE REPRODUCTIVE CAPACITY OF CALLOSOBRUCHUS MACULATUS. Brower, J. H. (Agricultural Research Service, Savannah). Ann. Entomol. Soc. Amer.; 66: No. 3, 617-619(May 1973).

Unmated pairs of Callosobruchus maculatus (F) were treated with gamma radiation dosages from 0.5 to 6.0 krad at 0.5 krad increments and allowed to mate and oviposit. The number of adult progeny per fertile pair and the percentage of sterility at each dosage were determined. The regression line for average number of adult progeny per pair and a probit sterility curve were used to determine 50% dosages for number of progeny and sterility, respectively. The average number of progeny per pair was reduced 50% by a dosage of 0.8 krad, but the number of sterile pairs was not increased by 50% until a dosage of 3.2 krad was used. The probit sterility line indicated that 7 krad is the sterilizing dosage for this species. (auth)

Radionuclide Effects (Internal Source)

2972 POINT BEACH THERMAL PLUME. Green, T.; MacKenzie, T.; Roffler, S.; Scarpace, F.; Sundby, C.; Keating, T. (Univ. of Wisconsin, Madison). pp 588-596 of Proceedings of the Fifteenth Conference on Great Lakes Research. Ann Arbor, MI; International Association for Great Lakes Research (1972).

From 15th conference on Great Lakes research; Madison, Wisconsin, USA (5 Apr 1972). See CONF-720451-.

Work aimed at describing a thermal plume is summarized. A comprehensive set of thermal imagery taken each five minutes for at least an hour on four separate occasions shows the surface temperature structure to be often dominated by a series of concentric thermal fronts spreading radially outward from the outfall. Similar fronts were seen in nearby plumes. Sharp temperature changes of over 2°C occur along these fronts. Concurrent surface temperature data taken by a ship-mounted radiation thermometer provides ground truth. The imagery has been analyzed using a densitometer to provide quantitative estimates of the speed and intensity of the fronts. On other occasions, detailed aerial photography of large numbers of drogues and a photogrammetric data reduction technique gave rather accurate information on the plume current structure. Internal waves and thermal turbulence associated with the bottom interface were measured using a fixed vertical array of five fast response thermocouples. Power spectra are presented. Rapid variations of temperature at the fixed point were encountered, which point to difficulties in interpreting data taken following the usual towed thermistor array procedure. (auth)

Man

Refer also to abstract 2905.

2973 (ORNL-TM-4154) CONTRIBUTION OF RADON IN NATURAL GAS TO THE NATURAL RADIOACTIVITY DOSE IN HOMES. Barton, C. J.; Moore, R. E.; Rohwer, P. S. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 29p. NTIS $3.50.

Data were obtained on the radon concentration in natural gas supplied to several metropolitan areas in the United States. The average value of 20 pCi/liter was selected to estimate the contribution of this source of natural radioactivity to doses from radon daughters received by individuals in homes. Radon daughter concentrations in the home atmosphere were calculated by use of computer programs for an 8000-ft^3 house in which 27 ft^3 of gas per day is used for cooking in an unvented kitchen range. The total estimated dose to the bronchial epithelium included contributions from radon daughters in the ventilation air, each of which was assumed to be present at a concentration of 0.13 pCi/liter, and from radon plus daughters in the natural gas. The latter contribution averaged approximately 3% of the total dose. There was a 3.5% decrease in the estimated total dose when the air change rate increased from 0.25 to 2.0 per hour. It was concluded that radon and radon daughters entering the home with natural gas produce a negligible fraction of the total home dose to the respiratory system of home occupants from airborne radon daughters. (auth)

2974 (WASH-1241) PLUTONIUM AND AMERICIUM MEASUREMENT IN HUMANS BY X- AND GAMMA-RAY SPECTRAL ANALYSIS. Yaniv, S. S. (Directorate of Regulatory Standards (AEC), Washington, D. C.). Apr 1973. 94p. GPO $2.35.

Thesis. Submitted to Pittsburgh Univ., Pa. (1969).

A method is described for the evaluation of human Pu-Am body burdens that is based on the analyses of spectral distributions of radiation emanating from Pu and Am. The spectra were obtained using Xe-filled proportional counter. The interactions of Pu and Am L x rays and Am 60-keV γ rays, with the Xe-filled proportional counter were investigated, and the effect of the escape from the counter of characteristic x rays of Xe on the observed spectrum is evaluated. Mathematical relationships, based on theoretical considerations and experimental data, relating the observed spectra to Pu and Am body content were developed. A computer program to calculate the body content was derived and is presented. Statistical limitations of the count procedure confine the described method to point sources of Pu-Am mixtures in which at least 2% of the α activity is due to Am activity, and to cases in which there is no significant internal contamination by radioisotopes other than those of Pu and Am. In cases of contamination by essentially pure plutonium the problem is simpler, since there are no ^{241}Am L x rays, nor are there problems associated with the escape of the characteristic x rays. Experimental tests, using a human phantom, also indicate that the method can be used for measurements of Pu-Am mixtures located in soft tissues up to a depth of not more than about 4 cm. (78 references) (CH)

2975 ISOTOPIC CISTERNOGRAPHY AND VENTRICULOGRAPHY. Critical Study of Ytterbium-DTPA. Barbizet, J.; Duizabo, P.; Thomas, J.; Galle, P.; Moretti, J. L.; Pitton, R. (Hopital Henri-Mondor, Creteil, France). Nouv. Presse Med.; No. 43, 2899-2901(2 Dec 1972). (In French).

The use of ytterbium complex with DTPA as a tracer in isotopic cisternography and ventriculography appears to be dangerous. Twelve patients suffering from various neurological diseases were studied. A radioactivity was observable during a three month period following its administration. The persistence of the activity is due to the fixing of the tracer on the meningo-encephalic structures. An attempt to displace the ^{169}Yb using chelating substances was unsuccessful. It was calculated that a dose of 1500 rads results from an injection of 1 mCi, a dose quite incompatible with diagnostic procedures. (France)

2976 CHANGES OF BLOOD CATALASE ACTIVITY FOLLOWING ADMINISTRATION OF SOME RADIOISOTOPES FOR DIAGNOSTIC PURPOSES. Olinescu, R.; Cotae, M. (Spitalul Fundeni, Bucharest). Rev. Roum. Med. Interne; 9: No. 3, 311-317(1972).

Changes in the level of blood catalase were observed following administration of some radioisotopes in small doses to patients with various diseases. The activity of blood catalase decreased significantly only in the case of the administration of ^{198}Au, an isotope with strong affinity for hepatic tissue. This decrease correlated significantly with the degree of hepatic injury as well as with the albumin/globulin ratio. (auth)

2977 ADVERSE REACTIONS TO RADIOPHARMACEUTICALS. Williams, E. S. (Middlesex Hospital, London). Brit. J. Radiol.; 46: No. 544, 320-321(Apr 1973).

A brief appeal is made to all United Kingdom users of radiopharmaceuticals to complete a British Institute of Radiology questionnaire concerning adverse reactions in patients. Stress is made on the equal importance of negative reports, including details of materials used and the number of investigations carried out. (UK)

Animals

Refer also to abstracts 2568 and 2990.

2978 (AEC-tr-7421, pp 52-57) KARYOMETRIC INVESTIGATION OF CELLS OF A LYMPHOID POPULATION OF THE RAT INGUINAL LYMPH NODE AFTER INTERNAL IRRADIATION WITH CESIUM-137. Khussar, Yu. P.; Tokin, I. B.; Pushchikov, E. P.; Khussar, V. S. (Scientific Research Inst. of Radiation Hygiene, Leningrad). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 840-843(1972).

A karyometric analysis of cells of the rat lymph node after a single oral administration of 40 μCi of cesium-137 showed that irradiation leads to a substantial increase in the area of the nuclei of the lymphocytes and a change in the nature of the distribution of the small, medium, and large lymphocytes in various zones of the lymph nodes. These changes are due to a sharp decrease in the number of small lymphocytes and an increase in the absolute volumes of the lymphoid cells. (tr-auth)

2979 NEOPLASMS INDUCED IN BABOON APES (PAPIO PAPIO) BY THE INHALATION OF PuO_2. Metivier, H.; Nolibe, D.; Masse, R.; Lafuma, J. (Centre d'Études de Bruyeres le-Chatel, Montrouge, France). Compt. Rend., Ser. D; 275: No. 25, 3069-3071(18 Dec 1972). (In French).

Young baboon apes (Papio papio) exposed to PuO_2 dust were found to exhibit lung cancer three months after having inhaled the toxic substance. The usefulness of extrapolating these results to the case of man is emphasized. (France)

2980 TEMPORAL CHANGES IN THYROID HORMONE BIOSYNTHESIS AFTER ADMINISTRATION OF RADIOACTIVE IODINE (^{131}I). Iigaya, K. (Showa Univ., Tokyo). Showa Igakkai Zasshi; 32: No. 7, 328-337(Jul 1972). (In Japanese).

Male rats of Wistar strain were divided into groups. Fifty μci of ^{131}I were given intraperitoneally to group A and 200 μci of ^{131}I to groups B, C and D. After 24 hours of ^{131}I administration, 0.1 mg of methylmercaptoimidazole (MMI) was given daily to group C and 100 g of potassium iodide (KI) was given daily to group D for 6 days. Groups E and F were given only MMI and KI respectively and served as the control to groups C and D. Four hour-^{131}I uptake was determined and intrathyroidal iodoamino acids were analyzed paper-chromatographically for periods from 4 hours up to 60 days after the administration of ^{131}I. In the animals treated with 50 μci of ^{131}I, 4 hr-^{131}I uptake and thyroid hormone biosynthesis increased 24 hrs after, then remained within normal range. In the animals treated with 200 μci of ^{131}I, strong disturbances in iodine uptake were observed in the early stage, whereas the biosynthesis of intrathyroidal iodoamino acids was disturbed in all stages. Animals given either MMI or KI after ^{131}I administration showed less disturbance in iodine uptake in the early stage than in those given ^{131}I alone. Biosynthesis of intrathyroidal iodoamino acids in these animals remained normal for a longer period as compared with the animals given ^{131}I alone. Prevention of radiation hazards, however, cannot be expected by as large a dose of MMI or KI as this, since organization of iodine becomes intensely disturbed sooner or later. It is apparent from these data that administration of ^{131}I in large dose gives rise to strong dysfunction of the thyroid with no evident recovery, while in relatively small doses, iodine uptake is transiently stimulated, then disturbed, but returns to the normal level, and biosynthesis of intrathyroidal iodoamino acids remains normal for a long period. (auth)

2981 EFFECT OF IRRADIATED APPLE JUICE ON SPERMATOGENESIS IN MICE. Rath, R. K. (Orissa Veterinary Coll., Bhubaneswar, India). Indian J. Anim. Res.; 5: No. 1, 15-18 (1971).

The effect of irradiated apple juice (0.4 Mrad) on spermatogenesis was studied in 20 hybrid mice. In the developmental sequences of spermatogenesis in mice, no morphological or functional damages were observed. (Indian Sci. Abstr.)

2982 CARELESS TECHNOLOGY: ECOLOGY AND INTERNATIONAL DEVELOPMENT. Conference held at Warrenton, Virginia, December 8–11, 1968. Farvar, M. T.; Milton, J. P. (eds.). Garden City, NY; Natural History Press (1972). 1054p. (CONF-681233–). $25.00.

From the careless technology ecology and international development conference; Warrenton, Virginia, USA (8 Dec 1968).

Separate abstracts were prepared on three papers. Forty-six additional papers discuss nutrition and health, the ecological consequences of irrigation and water management, and the ecological consequences of the intensification of agricultural practices related to increased production of both animals and crops. (CH)

For abstracts of individual chapters see: 2568, 2628, and 2983.

2983 ATOMIC WASTE DISPOSAL IN THE SEA: AN ECOLOGICAL DILEMMA. Hedgpeth, J. W. (Oregon State Univ., Corvallis). pp 812-828 of Careless Technology: Ecology and International Development. Farvar, M. T. Garden City, NY; Natural History Press (1972).

From the careless technology ecology and international development conference; Warrenton, Virginia, USA (8 Dec 1968). See CONF-681233–.

A by-product of the atomic age is the addition of artificial radionuclides to the environment. Some of these occur naturally; others were previously unknown. While potentially dangerous, high-activity radionuclides must be buried or encapsuled, the greater bulk of this material is so-called low-level waste, and much of this is discharged into the sea. Research into the effect of these low-level wastes on marine life has hardly begun, but opposing points of view have already developed about these effects in the Soviet Union and the rest of the world. The Soviet researchers take the conservative view that any addition to the sea is harmful, while the Western researchers defend the position that the levels of artificial radioactivity from present controlled releases are too low to have significant effect on marine life and are less than the activity induced by bomb tests. No information is available on what might be considered permissible levels for creatures other than man, but there may be a difference in philosophy that accepts losses of a certain percentage to a fish population that would be ethically unacceptable for mankind. (auth)

Plants

2984 (NP-19717) VARIATION AND COMPARISON OF THE SUBCELLULAR LOCALIZATION OF ZINC IN DIVERSE BROAD BEAN VICIA FABA TISSUES OF INCREASING DEVELOPMENTAL STAGES. Polar, E. (Cekmece Nuclear Research and Training Center, Istanbul (Turkey)). 1972. 67p. Dep. NTIS (U. S. Sales Only) $5.50.

The subcellular distribution and the chemical form of zinc present in young and old leaf, stem, and root tissues were investigated using ^{65}Zn and combining the results from differential centrifugation and chromatographic techniques. It was observed that zinc content expressed on a cpm/mg (dry weight) basis, was highest in the soluble fraction from young roots, with about 18% associated with amino acids, most of the rest being in an ionic form. As roots grew older, zinc present in the soluble fraction decreased relatively with the major part in an ionic form. A decrease also occurred in the particulate fractions compared to those of young roots, with zinc content still higher in the ribosomal and 30,000×g fractions. An overall increase of zinc content was observed in all fractions from old stem homogenates, in contrast to those of leaves and roots, except for the loss of this trace element in whole chloroplast fraction. The association of zinc with proteins increased in younger leaves, at the expense of ionic zinc, while that with amino acids remained constant. (HLW)

Nuclide Kinetics and Toxicology

Man

Refer also to abstracts 2505 and 2601.

2985 (FRNC-CONF-66) ELIMINATION OF ^{224}Ra INTRODUCED BY INTRA-ARTICULATORY INJECTION. Louyot, P.; Laurent Montet, Y.; Bertrand, A.; Stines, J.; Pourel, J. (Clinique Rhumatologique, Nancy (France)). 1971. 6p. (In French). (CONF-710563-5). Dep. NTIS (U. S. Sales Only) $3.00.

From meeting on radioisotope synoviotherapy (synovior thesis); Paris, France (26 May 1971).

The different properties of ^{224}Ra are reviewed and it is shown that the currently available commercial product is pure and suitable for therapeutic use. The disappearance of the product from the articulation, its elimination in the urine (2% of the total dose injected) and in the feces (30 to 40%) are discussed. (France)

2986 MATERNAL-FETAL EXCHANGE OF ^{59}Fe: RADIATION DOSIMETRY AND BIOKINETICS IN HUMAN AND SHEEP STUDIES. Dyer, N. C.; Brill, A. B.; Raye, J.; Gutberlet, R.; Stahlman, M. (Vanderbilt Univ., Nashville). AT(40-1)-2401. Radiat. Res.; 53: No. 3, 488-495(Mar 1973).

The estimation of the absorbed radiation dose to the human fetus from ^{59}Fe administered to the mother requires information on the biokinetics of the ^{59}Fe within the mother and fetus. For the first part of pregnancy, up to about 24 wk gestation, information from studies done on women receiving therapeutic abortions is available. However, for the late gestational stages it is necessary to utilize data from animal studies. Maternal-fetal biokinetic studies were done on six late gestational stage ewes with chronic in-dwelling catheters in both the ewe and in utero fetus. The iron tracer, ^{59}Fe, was injected into the maternal circulation simultaneously with an ^{55}Fe injection into the fetal circulation. Transport between ewe and fetus was measured up to 110 hr after injection and tissue distribution was determined from autopsy specimens obtained at sacrifice. Fractional transport of the ^{59}Fe tracer to the fetus was 0.64% of the dose given the ewe. Extrapolation of the sheep data to the human situation was accomplished by comparing early gestational stage human and sheep data. With these extrapolated data, the absorbed radiation dose to the 36 to 38 wk gestational age human fetus was estimated to be 25 rad per mCi of ^{59}Fe administered intravenously to the mother. (auth)

2987 INFLUENCE OF TEMPERATURE ON THE COPRECIPITATION OF STRONTIUM, BARIUM, AND RADIUM WITH A PROTOTYPE OF THE BONE MINERAL, ARTIFICIAL CALCIUM HYDROXYLAPATITE. Popov, D. K.; Mikhailova, A. I.; Basalaeva, L. N. Sov. Radiochem. (Engl. Transl.); 14: No. 4, 675-676(1972).

Translated from Radiokhimiya; 14: No. 4, 651-656(1972).

In the temperature interval (18 to 37)°C, the distribution of strontium, barium, and radium between solutions and precipitates of calcium hydroxylapatite (a prototype of the bone mineral) does not depend on the temperature. (auth)

2988 FATE AND DOSIMETRY OF TWO LUNG SCANNING AGENTS, ^{131}I MAA AND ^{99m}Tc FERROUS HYDROXIDE. Galt, J. M.; Tothill, P. (Univ. of Edinburgh). Brit. J. Radiol.; 46: No. 544, 272-276(Apr 1973).

The administration of the ^{131}I macroaggregated albumin (MAA) and ^{99m}Tc ferrous hydroxide for lung scanning provided an opportunity for studying the distribution of radioactivity at different times and assessing the radiation dose to various organs. The ^{131}I MAA was nearly all trapped initially in the lungs. The half-time of clearance was approximately 9 hr, and the ^{131}I was mostly released as iodide, activity appearing in the stomach, rather than the liver. The absorbed radiation dose to the lungs averaged 1.4 rads from an administration of 250 μCi. Thyroid blocking proved to be incomplete, and doses ranged from 3 to 22 rads. The initial concentration of the ^{99m}Tc agent was largely in the lungs, although an appreciable but variable proportion lodged in the liver. The absorbed dose to the lungs was approximately 0.4 rad per mCi administered. Studies with ^{59}Fe labeling of the ferrous hydroxide demonstrated that elimination of the iron from the lungs was relatively slow, a multiple exponential clearance being found. Although the initial half-life was 21 days, activity was still detectable in the lungs 110 days after administration. (auth)

2989 STRONTIUM-90 CALCIUM INTERRELATIONSHIPS IN MAN. Spencer, H. (Veterans Administration Hospital, Hines, IL); Kramer, L.; Samachson, J.; Hardy, E. P. Jr.; Rivera, J. Health Phys.; 24: No. 5, 525-533(May 1973).

Strontium-90-calcium interrelationships have been studied by determining ^{90}Sr and calcium balances in man during the intake of different dietary levels of ^{90}Sr and of calcium. On a calcium intake of about 1 g/day, given as milk, the urinary ^{90}Sr/Ca ratio was about the same as the dietary ^{90}Sr/Ca ratio and therefore the Observed Ratio (O.R.) urine/diet was about 1, while on low calcium intake and on supplementing the diet with calcium as the gluconate the urinary ^{90}Sr/Ca ratio differed considerably from the ^{90}Sr/Ca ratio of the diet and the O. R. urine/diet was variable. The O. R. stool/diet was about 1 on all calcium intake levels. Stable calcium did not significantly decrease the net absorption of ^{90}Sr, $P < 0.1$. (auth)

Animals

Refer also to abstracts 2574, 2609, 2927, 2943, 2980, and 2597.

2990 (AEC-tr-7421, pp 124-128) DISTRIBUTION AND BIOLOGICAL ACTION OF CALIFORNIUM-252. Zalikin, G. A.; Moskalev, Yu. I.; Lyubimova-Gerasimova, R. M.; Petrovich, I. K.; Stepanov, V. S. (Inst. of Biophysics, Moscow). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 894-897(1972).

The distribution and biological effects of californium-252 at doses from 0.0005 to 0.064 μCi/g (eight doses) were investigated. One to two days after intravenous injection of the nitrate of californium-252 into rats, up to 65 to 68% of the isotope is retained in the liver and up to 26 to 32% in the skeleton. The values of $LD_{50/15}$ and $LD_{50/30}$ proved equal to 0.032 and 0.012 μCi/g, respectively. When californium-252 is administered in the acute toxic doses, the animals develop a pronounced agranulocytic syndrome, and in the terminal period the blood pressure drops. Californium-252 proved to be five times as toxic as americium-241 and nine times as toxic as curium-244. (tr-auth)

2991 (CEA-R-4405) INFLUENCE OF COMPLEXING MOLECULES ON THE BIOLOGICAL BEHAVIOR OF RADIOCERIUM IN THE RAT PLASMA. Masse, R.; Giuliano, C.; Arnoux, B.; L'Hullier, I.; Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Mar 1973. 19p. (In French). Dep. NTIS (U. S. Sales Only) $3.00

The influence of different concentrations of EDTA citrate, lactate, and bicarbonate on the physico-chemical behavior and the metabolism of cerium was studied. The various complexes were analyzed and their effects on radiocerium renal elimination and uptake in the rat are discussed. (auth)

2992 (CNEA-324) COMPARATIVE STUDY OF THE METABOLISM IN RATS OF ^{210}Pb AND ^{210}Po. Beninson, D.; Nowotny, G.; Guerrien, D.; Bonino, N. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

Basic parameters necessary to evaluate integrated exposure to radon and its decay products in affected personnel working as miners in the uranium field were studied. Metabolism of ^{210}Pb and ^{210}Po was studied in detail over a period of about two years using rats as experimental animals. A series of parameters of interest was determined among which were body retention and rate of elimination for both radionuclides, a transfer factor from blood to the skeleton for ^{210}Pb of 0.22 ± 0.02 (standard error of the average) and a ratio of $3.4 \times 10^{-4} \pm 0.2 \times 10^{-4}$ between ^{210}Po eliminated in the urine per day and the ^{210}Pb deposited in bone. From the experimental results there arises the possibility of estimating, starting with the urinary excretion of ^{210}Po, the burden of ^{210}Pb deposited in the bone, and from this, the pulmonary exposure resulting from its precursors. (tr-auth)

2993 INFLUENCE OF GLUCOCORTICAL HORMONE IN ACTINOMYCIN D ON THE UPTAKE OF LABELLED AMINO ACIDS IN GRANULOMAS. Oronsky, A. L.; Nocenti, M. R. (Columbia Univ., New York). Arch. Int. Pharmacodyn.; 195: 16-23(1972).

The effect of hydrocortisone acetate (FAc) and actinomycin D on protein metabolism in vivo in cotton sponge-induced granulomas was investigated. Impregnation of the sponge with 300 μg of FAc or 10 μg of actinomycin D prior to implantation inhibited granuloma growth as early as 6 hours after implantation. Furthermore, both FAc and actinomycin D significantly decreased the total labelled amino acid incorporation (^{14}C-proline and ^{14}C-glycine) as well as specific activity (cpm/μg protein) at 3, 6, 12 and 24 hours after granuloma induction. In addition, 10 mg of puromycin paralleled the effects on granuloma development (wet weight) of actinomycin D and FAc. It is suggested that the FAc impairment of protein synthesis may be of considerable importance in the ability of the hormone to inhibit the development of granulation tissue. (auth)

2994 METABOLISM OF RADIOACTIVE NUCLIDES IN THE JUVENILE MAMMAL. I. Estimated Dose to the Intestine of the Juvenile Rat Due to Orally Administered ^{141}Ce. Inaba, T.; Ichikawa, R. (National Inst. of Radiological Sciences, Chiba, Japan). Hoken Butsuri; 7: No. 3, 141-145(Sep 1972). (In Japanese).

Cerium-141 given orally was retained in the whole body for much more prolonged time by suckling than by weanlings or adult rats. Distribution studies showed that ^{141}Ce given orally to suckling rats was retained in the intestinal tract and little was transferred to the other organs or tissues, although the intestinal absorption rate was much higher than that of adult rats. Intestinal radiation doses of orally given ^{141}Ce in the suckling, weanling, and adult rat were calculated on the assumption that ^{141}Ce was distributed uniformly in the intestinal tract. The results showed that the intestinal dose of the suckling rat was higher than that of the weanling or adult rat. Because of the higher intestinal dose and the high intestinal absorption of ^{141}Ce in the suckling rat, the radiocerium should be considered as more hazardous than previously regarded. (auth)

2995 RETENTION AND EXCRETION OF INJECTED ^{181}W-LABELED SODIUM TUNGSTATE BY BEAGLES. Aamodt, R. L. (Univ. of Rochester, NY). Health Phys.; 24: No. 5, 519-524(May 1973).

Retention and excretion were measured in purebred beagles, 18 months old, given 1.5 to 2.3 μCi of ^{181}W as sodium tungstate in normal saline. The dogs were injected in the cephalic vein with 1 to 1.5 ml of the tungsten solution. Urine and feces were collected separately and body burdens were determined by in vivo gamma ray counting. Over a period of 131 days, retention (R) could be represented by the equation: $R = 0.816e^{-11.6t} + 0.151e^{-1.88t} + 0.022e^{-0.19t} + 0.011e^{-0.007t}$ where t is the time after injection in days. The excretion data generally agreed with whole body gamma measurements. Blood was taken until its activity was less than the detection limits of the counter. Loss from the blood was rapid during the first 24 hr post-injection and most of the activity was found in the plasma. Comparison of urine and feces indicated that ^{181}W was excreted primarily in the urine. Measured urine to feces ratios tended toward 38 after 10 days post-injection and were relatively constant after 9 days. (auth)

2996 MORPHOLOGICAL STUDY OF ALVEOLAR HISTOCYTES AFTER THE IN VITRO PHAGOCYTOSIS OF PuO_2 USING MICROCINEMATOGRAPHY AND SCANNING ELECTRON MICROSCOPY. Nolibe, D. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Compt. Rend., Ser. D; 276: No. 1, 65-68 (3 Jan 1973). (In French).

The in vitro phagocytosis of PuO_2 particles by alveolar histocytes was established. It was demonstrated that the same cell can suc-

cessively phagocytize several granules in spite of the heavy irradiation suffered as a result. The small number of ultrastructural alterations detected in the cells containing PuO_2 indicates the large radioresistance of this type of cell. However, in vitro experiments indicate that this radioresistance is limited. In particular, after poisoning, the alveolar histocytes exhibited a reduced spreading and displacement capacity on the substrate; after 24 hrs survival, some of these presented lysis. An active role can be attributed to the alveolar histocytes in eliminating the inhaled particles, which can be related to the problems involved in lung purification occurring with animals having inhaled PuO_2. (France)

2997 EXPERIMENTAL INHALATION OF METALLIC SILVER. Phalen, R. F.; Morrow, P. E. (Univ. of Rochester, NY). Health Phys.; 24: No. 5, 509-518(May 1973).

Dogs were tracheally intubated and exposed to airborne particles produced by exploding radioactive silver wires. The particles were agglomerates of spherical primaries and had activity median aerodynamic diameters near 0.5 μ. The deposition fraction in the respiratory tract was 0.17 ± 0.05; absolute deposition averaged about 1 mg/kg of body weight. Translocation and clearance of the deposited material were followed by external gamma ray detectors collimated to measure activity at several sites in each animal. Clearance data were analyzed into exponential components. The lung had biological clearance half-lives of 1.7, 8.4, and 40 days accounting respectively for about 59, 39, and 2% of the total amount deposited. Corresponding values for the liver were 9 (97%) and 40 days (3%). Excretion was predominantly fecal, the major portion of which was believed to have been secreted into the bile. Sacrifice measurements showed that the liver was a major site for the deposition of silver. Lung, brain, and muscle also contained relatively large accumulations. Results showed that existing ICRP biological values for evaluating the hazards from radioactive silver are unreliable for inhalation. For example, considerably more silver (perhaps 90% of that initially deposited in the lungs) was absorbed into the body for general internal distribution, than would be calculated from the ICRP figures. (auth)

2998 EFFECTS OF PENICILLAMINE ON THE BODY BURDENS OF SEVERAL HEAVY METALS. Silva, A. J.; Fleshman, D. G.; Shore, B. (Univ. of California, Livermore). Health Phys.; 24: No. 5, 535-539(May 1973).

Penicillamine added to food was effective in decreasing the body burden of several radionuclides ingested by rats. Penicillamine (50 mg/day), administered 12 hr after exposure to ^{198}Au, ^{203}Hg, and ^{210}Pb, produced lower whole-body levels of the isotopes than in control animals. Barium-133 activity was unaffected by penicillamine treatment up to 75 days. Individual radionuclide retention after oral administration of the mixed radionuclides was measured by whole-body counting of the rats on Ge–Li detectors. (auth)

2999 INFLUENCE OF AGE AND SEX ON THE METABOLISM OF AMERICIUM BY RATS. Durakovic, A. B.; Hollins, J. G.; Storr, M. C. (National Research Council of Canada, Ottawa). Health Phys.; 24: No. 5, 541-546(May 1973).

The retention of ^{241}Am by the whole body and tissues was studied in male and female rats of four ages after intravenous injection of americium in the form of citrate. Significant variations of the metabolism of americium with age and sex were demonstrated in kidney, liver, and bone. The concentration of americium by kidney and liver was positively correlated with age, while the concentration by bone was negatively correlated with age. The concentration of americium by kidney and bone was greater in male than in female rats, but the concentration by liver was greater in the female rats. The radiotoxicological implications of these results are discussed. (auth)

3000 MEASUREMENT OF IN VITRO DISSOLUTION OF AEROSOL PARTICLES FOR COMPARISON TO IN VIVO DISSOLUTION IN THE LOWER RESPIRATORY TRACT AFTER INHALATION. Kanapilly, G. M.; Raabe, O. G.; Goh, C. H. T.; Chimenti, R. A. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Health Phys.; 24: No. 5, 497-507(May 1973).

Dissolution and transport of particles deposited in the lower respiratory tract (LRT) are important factors when estimating clearance and the long-term hazard associated with inhaled radioactive aerosols. Three methods for the in vitro determination of rates of dissolution in simulated biological fluids of respirable particles are described. Short term in vitro dissolution patterns of $^{144}CeCl_3$ aerosol particles and various samples of ^{95}Zr-^{95}Nb aerosol particles were determined and compared with data on the in vivo dissolution of similar particles in the LRT of experimental animals. General agreement between the in vitro and in vivo dissolution patterns was observed. The long-term (weeks) in vitro rates of dissolution of narrow size group ^{90}Sr-fused clay particles were measured in static and parallel flow systems. The rate constants of dissolution of ^{90}Sr-fused clay particles in the two systems were calculated as 3.1×10^{-8} g/cm^2/day and 3.3×10^{-8} g/cm^2/day, respectively. The estimated rate constant of dissolution of ^{90}Sr-fused clay particles in the LRT of a Beagle dog, 3.4×10^{-8} g/cm^2/day, was in good agreement with the in vitro rate constant of dissolution. (auth)

3001 OUABAIN STIMULATION OF $^{45}Ca^{++}$ ACCUMULATION IN THE RAT PITUITARY. Fleischer, N.; Wood, J. M. (Baylor Coll., Houston, TX). Endocrinology; 92: No. 5, 1555-1559(May 1973).

Anterior pituitary tissue from rats was incubated at 37°C in Krebs' Ringer's bicarbonate in an atmosphere of 95% O_2 and 5% CO_2 with hourly changes of the incubation media. After a one hour preincubation, $^{45}Ca^{++}$ was added to the media and its uptake by the pituitary tissue was determined. The digitalis glycoside, ouabain, in concentrations of 5×10^{-4} and 1×10^{-3} M significantly augmented pituitary $^{45}Ca^{++}$. This effect was dose and time dependent. Ouabain did not alter the washout kinetics for ^{14}C inulin or affect pituitary weights suggesting that the observed changes in $^{45}Ca^{++}$ content were the result of increased $^{45}Ca^{++}$ accumulation. The effect of ouabain on calcium flux may be related to the stimulation of ACTH and GH release by ouabain. (auth)

3002 METABOLISM OF PERCHLORATE IN THE RAT. Goldman, S. J.; Stanbury, J. B. (Massachusetts Inst. of Tech., Cambridge). Endocrinology; 92: No. 5, 1536-1538(May 1973).

The disposal of $K^{36}ClO_4$ was studied in rats maintained on a low iodine diet. After intraperitoneal administration the radionuclide reached its maximal concentration in the thyroid at about 4 hr and at a level of approximately 2.5% of dose per g gland. All the radionuclide in the thyroid was trichloroacetic acid soluble. No significant concentration was found in kidney, liver, brain or spleen. The rates of disappearance of the radionuclide from the plasma and thyroid and rate of appearance in the urine were exponential, with half times of approximately 20 hr. These rates were closely similar to disposal rates of ^{131}I found by others. (auth)

3003 EXCRETION AND BODY DISTRIBUTION OF PROMETHIUM 147. A Study in Rats after Intramuscular Injection. Herman, M. W.; Clark, A. J. (Univ. of California, Los Angeles). Arch. Environ. Health; 26: No. 5, 260-263(May 1973).

Rats were injected intramuscularly with 1 microcurie of promethium chloride Pm-147. Distribution of the isotope in body tissue and relative rate of excretion in urine and feces were different from previously reported studies in which the isotope was administered intravenously. The major route of isotope excretion both in rats given a diet and those fasted was via the intestinal tract, with the largest amount being excreted the second day after injection. Urinary excretion of the isotope was greatest during the first 24 hours after injection and then declined markedly in subsequent days in both fed and fasted rats. Within 24 hours, the liver showed the highest activity (20% of the administered dose) as compared to blood, kidney, and bone. Activity of the isotope in injected muscle for the first three days was greater than in noninjected muscle. (auth)

New Tracer Techniques

Refer also to abstracts 2476 and 2975.

3004 DEPRESSION OF THE INTESTINAL UPTAKE OF RADIO-VITAMIN B_{12} BY CHOLESTYRAMINE. Coronato, A.; Glass, G. B. J. (New York Medical Coll., NY). Proc. Soc. Exp. Biol. Med.; 142: No. 4, 1341-1344(Apr 1973).

Cholestyramine decreased the intestinal absorption of radio-B_{12} as measured by the double label hepatic uptake test in 10 consecutive normal adult volunteers, and in a patient with pernicious anemia. The mechanism of this inhibition was explored in vitro using the guinea pig intestinal mucosal homogenate assay. The in vitro studies suggested that cholestyramine decreased intrinsic factor-mediated B_{12} absorption probably by binding to a portion of the same binding sites on the intrinsic factor molecule which normally B_{12}. This would impair the formation of the intrinsic factor-B_{12} complex. (auth)

3005 MULTICHANNEL SYSTEM FOR STUDY OF THE CEREBRAL CIRCULATION. Bell, R. L.; Jensen, D. W. (Veterans Adminstration Hospital, Coatesville, PA). Int. J. Appl. Radiat. Isotop.; 24: No. 4, 236-238(Apr 1973).

A multichannel system consisting of six scintillation probes having identical crystals connected to three dual channel ratemeters for the measurement of velocity and flow of labeled radioactive material in the central nervous system is described. With multiple probes it is possible to obtain more reliable information than was possible by the multiple adjustments of two scintillation probes as used previously. However the system does have certain

limitations such as the problems of adjusting the detector gains, of equalizing the tape deck amplifiers, and of checking reproducibility of the circuitry. A mathematical model is presented of the cerebral circulation that would theoretically permit the solution of the problem of flow. (UK)

3006 PREPARATION OF STABLE LABELED (^{15}N, ^{13}C, ^{2}H) NATURAL PRODUCTS BY MEANS OF AUTOTROPHIC ALGAE CULTURES AND NEW APPLICATIONS OF STABLE ISOTOPES IN THE BIOSCIENCES. Jung, G.; Juettner, F. (Tuebingen Univ., Ger.). Chem. Ztg.; 96: No. 11, 603-611(1972). (In German).

The development of sensitive instruments for routine analysis of stable isotopes (mass spectrometer coupled with gas chromatograph, emission spectrometer for ^{15}N, infrared spectrometer, pulse-Fourier-transform nuclear magnetic resonance spectrometer) opens new and broad fields in the application of stable isotopes in all biosciences and in chemistry particularly for ^{13}C, ^{15}N, ^{2}H, and ^{18}O. Stable labeled organic basic compounds of metabolism are prepared beneficially with the aid of autotrophic algae cultures with selected species of green and blue algae. Optimal use of the ^{15}N-nitrate, ^{13}C-carbon dioxide, ^{2}H- and ^{18}O-water given to the growing algae is achieved in fully automated large-scale cultivation apparatus and by optimized separation procedures of the algae hydrolysates yielding stable labeled natural products. Selected examples of recent applications of compounds labeled with stable isotopes are discussed. (GE)

3007 QUANTITATIVE ESTIMATION OF PINOCYTOSIS USING RADIOACTIVE COLLOIDAL GOLD. Davies, P.; Allison, A. C.; Haswell, A. D. (Clinical Research Centre, Harrow, Eng.). Biochem. Biophys. Res. Commun.; 52: No. 2, 627-634(15 May 1973).

Radioactive colloidal gold has been used as a quantitative indicator of the pinocytic activity of mouse peritoneal macrophages. The uptake of label is both time and temperature dependent, accumulation being linearly related to time for several hours. Uptake is also dependent on the number of cells and concentration of the radioactive label. Increasing concentrations of newborn calf serum in the culture medium cause dramatic increases in pinocytosis without corresponding increases in protein levels in the cells. (auth)

3008 HAPTEN-RADIOIMMUNOASSAY OF PLASMA ESTRADIOL. Doerr, P. (Max-Planck-Institut fuer Psychiatrie, Munich). Acta Endocrinol.; 72: 330-334(1973).

A hapten-radioimmunoassay for plasma estradiol is described and information about the reliability of the method is given in detail. Estradiol-3-hemisuccinate coupled to keyhole limpet hemocyanin is used for immunization of rabbits. The antiserum utilized for the assay is characterized by its titer, affinity, and specificity. Following ether extraction and NaOH-light petroleum partition, estradiol is separated from cross-reacting estrogens by TLC (thin-layer chromatography). Oxidation of estradiol on the plate is prevented by mercaptoethanol. To separate free and antibody bound ligand, 250 µg of dextran-coated charcoal per tube is used in the presence of bovine serum gamma globulin (1 mg/ml). The between-assay precision based on 15 different determinations of control samples from normal adult male plasma was 9.4% (C.V.). The mean reagent blank value of 31 determinations was equivalent to 0.3 pg estradiol and the detection limit in terms of the 99% confidence limit for a single blank value, was equivalent to 4.3 pg estradiol. A procedure for detecting plasma blanks is described. Plasma estradiol is separated from approximately all concomitant substances originally present in the sample by enzymatic conversion into estrone and a second TLC. No plasma blanks could be detected with respect to normal adult male plasma. Normal values for adult males based on 51 subjects were characterized by a median of 17.2 pg/ml and the 95 percentiles of 9.5 to 27.6. (auth)

3009 RADIOIMMUNOASSAY OF PROGESTERONE IN PERIPHERAL PLASMA OF THE DOMESTIC FOWL IN VARIOUS PHYSIOLOGICAL STATES AND IN FOLLICULAR VENOUS PLASMA. Furr. B. J. A. (National Inst. for Research in Dairying, Reading, Eng.). Acta Endocrinol.; 72: 89-100(1973).

A radioimmunoassay for estimation of progesterone in plasma from the domestic fowl is described. Antibodies were raised in goats to progesterone conjugated at the 11 position of the steroid nucleus to bovine serum albumin. An antiserum of high specificity was obtained, which allowed the estimation of progesterone in extracts of plasma without purification. The sensitivity of the assay, which was 25 pg using an antiserum dilution of 1:8000, allows the determination of progesterone in 200 µl plasma. The accuracy and precision of the method were highly satisfactory. Plasma progesterone levels in laying hens ranged from 0.67 to 9.60 ng ml^{-1} with a mean value of 3.13 ± 0.37 ng ml^{-1}, but were low (<0.10 to 0.67 ng ml^{-1}) in plasma from moulting, ovariectomized, and hypophysectomized hens and in plasma of intact and castrated cockerels. Progesterone concentrations in blood obtained from a follicular vein ranged from 12.8 to 133.1 ng ml^{-1}; these values were 8 to 50 times higher than in peripheral blood collected concurrently. The results suggest that high concentrations of progesterone found in the blood of laying hens are associated with the ovulatory cycle and that the preovulatory follicle secretes significant amounts of progesterone. (auth)

3010 COMPARISON OF THREE RADIOIMMUNOASSAY TECHNIQUES FOR THE MEASUREMENT OF SERUM IgE. Polmar, S. H.; Waldmann, T. A.; Terry, W. D. (National Cancer Inst., Bethesda, MD). J. Immunol.; 110: No. 5, 1253-1261(May 1973).

Three radioimmunoassay techniques [double antibody, Sepharose-bound antibody and bromacetylcellulose (BAC)-bound antibody] were compared. These three methods were used to measure the immunoglobulin E levels in sera of patients with schistosomiasis with very high IgE levels, in sera from normal adults, and in sera that were presumed to have very low IgE levels, including sera from immunodeficient patients and from a variety of non-primate species. There was, in general, good agreement among the three methods when the IgE concentration was elevated, as in patients with schistosomiasis and in some normal adults. In contrast, very significant differences in the estimates of the IgE concentration of the same serum were observed with the different techniques when the serum IgE levels were low. IgE was very low or undetectable in sera of many patients with immunodeficiency when studied by the double antibody technique, but these IgE deficiencies were often missed when the Sepharose or BAC techniques were used. For example, the IgE levels were found to be less than 15% of normal for 80% of the patients with ataxia telangiectasia studied by the double antibody technique, but IgE levels appeared to be normal when assayed by the Sepharose and BAC techniques. The IgE levels determined by the Sepharose method in patients with immunodeficiency were intermediate between the lower double antibody and the higher BAC values. Similarly, sera of various non-primate species were found to inhibit significantly the binding of radiolabeled IgE to the insoluble anti-IgE antibody and gave significant apparent IgE concentrations when the BAC or Sepharose techniques were used, but not when the double antibody technique was used. Thus, the BAC and, to a lesser extent, the Sepharose technique appeared to give falsely high IgE estimates when the levels of human IgE in the serum were low. The double antibody radioimmunoassay appears to be the method of choice for the measurement of serum IgE because it has greater sensitivity and reproducibility, and especially because it gives meaningful estimates for IgE in the critically important low IgE range observed with immunologic deficiency. (auth)

3011 RAPID SKELETAL IMAGING USING ^{18}F AND A DIVERGING COLLIMATOR. Reilly, J. A.; Johnson, P. M. (Columbia Univ., New York). Radiology; 107: No. 2, 373-375(May 1973).

A method is described for rapid imaging of ^{18}F distribution in the skeleton using the Anger scintillation camera and a diverging 410 KeV collimator. The method proved as sensitive as rectilinear bone scanning in detecting abnormal osteoblastic activity in 30 patients undergoing concurrent examinations. The discontinuous nature and flexibility of the method minimize patient discomfort and facilitate immediate supplemental study of suspicious areas. These advantages appear to outweigh the inherent slight loss of resolution due to septal penetration and minification. (auth)

3012 RADIOAEROSOL TECHNIQUE FOR ^{113m}In LUNG SCINTIGRAPHY. Lin, M. S.; Burke, G.; Silverstein, G. E. (Michael Reese Hospital and Medical Center, Chicago). Radiology; 107: No. 2, 449-451(May 1973).

A radioaerosol technique for ^{113m}In lung scintigraphy is described. The indium aerosol is generated in an ultrasonic nebulizer and inhaled via a disposable one-way breathing system. The technique is simple, safe, and capable of providing satisfactory lung images. (auth)

MATERIALS

3013 PERTURBED ANGULAR DISTRIBUTION FOLLOWING NUCLEAR REACTIONS. Recknagel, E. (Freie Univ., Berlin). Rev. Roum. Phys.; 17: No. 4, 473-503(1972).

This review gives a brief account of the state of art in PADENR (perturbed angular distribution experiments following nuclear reactions). Special problems arising from the nuclear reaction process are considered, an introduction is given to experimental methods used to study PADENR, and a survey is given of results on nuclear moments. Examples of the application of PADENR to solid-state problems are discussed. Four tables of magnetic moments measured by spin-rotation (DPAD), stroboscopic (SOPAD), γ-NMRPAD, and β-NMRPAD methods are included, with 39 references. (21 figures, 31 references.) (DLC)

3014 VAPOUR GROWTH AND EPITAXY. Proceedings of the Second International Conference, Jerusalem, Israel, May 21-25, 1972. Cullen, G. W.; Kaldis, E.; Parker, R. L.; Schieber, M. (eds.). J. Cryst. Growth; 17: 1-382(Dec 1972). (CONF-720584-).

From 2nd international conference on vapour growth and epitaxy; Jerusalem, Israel (21 May 1972).

Forty-six papers are presented, grouped in sections dealing with thermodynamics, kinetics of nucleation and growth, growth of single crystals, and thin films (III-V, II-VI, IV-VI compounds, Si, Ge, oxides on Si, liquid-phase epitaxy, etc). Author, subject, and compound indexes are included. Separate abstracts were prepared for four of the papers. (DLC)

For abstracts of individual papers see: 3108-3110 and 3175.

Ceramics and Cermets

Refer also to abstracts 2282, 2404, 2520, 2762, 3128, 3159, 3182, 3245, 3304, 3414, 4544, and 4642.

3015 (AERE-R-6897) THERMAL DIFFUSION MECHANISMS AND POSSIBLE MASS TRANSPORT PATHS IN CLOSED CARBIDE AND OXYCARBIDE SYSTEMS. Adamson, M. G. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 18p. Dep. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Several possible mechanisms for thermal diffusion of carbon fuels of varying purity have been identified as a result of thermodynamic analyses of the U-C, U-C-H, U-C-O and (U,Pu)-C-O systems. Predictions of the direction of carbon migration in an applied temperature gradient are made for the various solid-state and gas-phase mass transport paths and, wherever possible, these are compared with existing experimental data. After considering $UC_{1\pm x}$ and UC_{2-y} as hypothetical "pure" fuels, real carbide fuels containing significant levels of hydrogen and/or oxygen impurities are treated in terms of the appropriate multicomponent phase equilibria. Results of this experimental approach indicate that uranium and uranium-plutonium carbide fuels fabricated via carbothermic reduction of the oxide and, to a lesser extent, true monoxycarbide fuels will undergo simultaneous transport of carbon and oxygen down the temperature gradient when operated at high power ratings. The proposed mechanism is gas-phase transfer of carbon monoxide which, in closed systems, would lead to a spatial separation of solid phases and, under certain conditions, the production of a liquid-metal phase at highest temperatures. This mechanism is offered as an alternative explanation for the results of some thermal diffusion experiments performed on hyperstoichiometric uranium carbide. (auth)

3016 (AERE-R-7319) ELECTRON-DIFFRACTION DATA FOR SILICON NITRIDE. Sharp, J. V.; Evans, A. G.; Hudson, B. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Most silicon nitride specimens have a complex microstructure with both phases of silicon nitride present. Transmission electron microscopy is a very useful technique for examination of the fine-scale microstructure and electron-diffraction patterns can be obtained from small areas for identification of the structure. Electron-diffraction data are presented for both α and β phases of silicon nitride. Interplanar spacings and angles, relative spot intensities, and two beam extinction distances were computed, enabling a range of typical diffraction patterns to be prepared for both phases. These are compared with some experimental examples showing that, in some cases, unambiguous identification of the structure is possible whereas in others the two structures cannot be differentiated. (auth)

3017 (CEA-CONF-2096) TECHNIQUE OF EXAMINATION AT A DISTANCE IN PREPARATION FOR THE STUDY OF FISSION-PRODUCT BEHAVIOR. Vignesoult, N.; Bazin, J.; Monier, J.; de Contenson, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1971. 30p. (In French). (CONF-720903-15). Dep. NTIS (U. S. Sales Only).

From 20th remote systems technology conference; Idaho Falls, Idaho, USA (17 Sep 1972).

The performances of ceramic fuels with metallic claddings are, for high specific powers and high rate of burnup, affected by the presence of fission products (soluble, insoluble, or volatile) formed during the irradiation. Several remote methods were developed to analyze the qualitative and quantitative distribution of these fission products. These include gamma spectrometric devices for detection and collimation which permit the determination of the longitudinal and radial distribution of activities as well as the absolute activities. The displacements of the fuel elements and the acquisition of data are managed by a computer. Microscopy and α and β autoradiography are essentially qualitative methods, permitting the combination of the radial distribution of fission products with the evolution of the microstructure. Microanalysis is particularly adapted to the qualitative and quantitative study of fission products. A hot probe was constructed for the study of samples irradiated up to 10 Ci at 0.75 MeV. The original points of each technique are described and their possibilities are illustrated using results obtained on ceramic fuel elements operated in fused regime at high rates of burnup. (tr-auth)

3018 (CEA-R-4402) CONTRIBUTION TO THE THERMODYNAMIC STUDY OF PLUTONIUM OXIDES AND MIXED URANIUM-PLUTONIUM OXIDES. Chereau, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Feb 1973. 120p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

Thesis. Submitted to Paris Univ., Orsay (France).

Direct measurements of $h_{O_2}^M$, partial molar enthalpy of mixing of oxygen, were performed in plutonium oxides PuO_{2-x} and mixed $(UPu)O_{2\pm x}$ oxides at 1100°C; a Tian-Calvet microcalorimeter was used in which the heat evolved in the system is measured at successive oxidation steps. The validity of the method was first demonstrated by measurements of the chemical diffusion coefficients of oxygen in the oxides under investigation from a study of the variation of electrical resistivity during oxidation. The variation of $h_{O_2}^M$ was then investigated, giving detailed information about the plutonium-oxygen phase diagram at 1100°C; in particular, a narrow two-phased domain $PuO_{1.70}-PuO_{1.71}$ and a large single-phased domain $PuO_{1.61}-PuO_{1.70}$ were evidenced. The formation enthalpies of Pu_2O_3 ($\Delta H_f^0 = -402.7$ kcal) and $PuO_{1.61}$ ($\Delta H_f^0 = -211.4$ kcal) were determined. The variations of $h_{O_2}^M$ in mixed oxides with various plutonium content were studied and compared with the results in pure oxides. These measurements were interpreted in terms of a model using statistical thermodynamics, where the existence of ordered domains is postulated, together with complex defects—ionized oxygen vacancies $V_O^{\cdot\cdot}$ and reduced cations Pu^{3+}. (auth)

3019 (CONF-730601-3) PREPARATION AND CHARACTERIZATION OF PYROLYTIC CARBON SEALANTS FOR GRAPHITE IN POWER REACTORS. Pollock, C. B.; Cook, W. H. (Oak Ridge National Lab., Tenn.). [nd]. 7p. Dep. NTIS $3.00.

From 11th biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

Graphite was sealed to helium permeabilities of $< 10^{-6}$ cm^3/sec by coating with isotropic layers of pyrolytic carbon. Monolayer coatings deposited at temperatures above 1200°C from propene and irradiated to a fluence of 10^{22} neutrons/cm^2 (>50 keV) at 700°C have shown satisfactory performance. Duplex coated specimens are being irradiated. (auth)

3020 (CONF-730601-4) RESIN FUEL PARTICLES FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Silverman, M. D.; Pollock, C. B. (Oak Ridge National Lab., Tenn.). 1972. 8p. Dep. NTIS $3.00.

From 11th biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

Fuel kernels for HTGR's have been prepared from both strong- and weak-acid cation exchangers. Carbonization and heat treatment studies conducted on these uranium-loaded resins have yielded kernels whose composition can be widely varied and correlated with theoretical predictions. (auth)

3021 (CONF-730601-5) IRRADIATION OF GRAPHITE AT 950°C. Kennedy, C. R. (Oak Ridge National Lab., Tenn.). [nd]. 7p. Dep. NTIS $3.00.

From 11th biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

Graphites of three types—conventional, carbon black, and apparently binderless—have been irradiated in HFIR at 950°C and the results compared with those obtained at 715°C. It is demonstrated that no growth rate increases are evident; however, the lifetime appears to be reduced. The implication is that at 950°C graphites have a reduced ability to absorb the differential growth-induced shear stress. (auth)

3022 (CONF-730601-6) DEVELOPMENT OF THERMAL-SHOCK-RESISTANT GRAPHITE. Kennedy, C. R.; Eatherly, W. P. (Oak Ridge National Lab., Tenn.). [nd]. 6p. Dep. NTIS $3.00.

From 11th biennial conference on carbon; Gatlinburg, Tennessee, USA (4 Jun 1973).

By careful pretreatment of green cokes, it has been found possible to more nearly match the shrinkage properties of filler and binder during heat treatment to produce artificial graphite bodies. This process has yielded materials which, on the basis of limited test data, appear to have significantly improved thermal shock resistance. The process is currently being scaled up to produce usable sizes for more extensive testing. (auth)

3023 (COO-3420-2) CERAMIC RESEARCH ON TRANSFORMATIONAL SUPERPLASTICITY AND STOICHIOMETRIC EFFECTS ON FRACTURE. Progress Report, June 1, 1972–May 31, 1973. Bradt, R. C.; Hoke, J. H. (Pennsylvania State Univ., University Park. Dept. of Materials Science). 1 Mar 1973. Contract AT(11-1)-3420. 29p. Dep. NTIS $3.50.

Pure Bi_2O_3 was found to exhibit superplastic behavior in the stable phases above and below the transformation; consequently, this offers the unique opportunity to directly compare intrinsic and extrinsic variables of superplasticity in the same material. Transformational superplasticity was also observed and identified in the binary Bi_2O_3–Sm_2O_3 eutectoid. Unlike pure Bi_2O_3, this material does not exhibit superplastic behavior above and below the transformation. The eutectoid composition was moderately well characterized, and one hypoeutectoid composition was prepared and is being studied. Extensive study of other hypo- and hypereutectoid compositions is planned, as well as study of other eutectoids and phase transitions. (auth)

3024 (DP-Report-610(Pt.1)) ORNL SOL-GEL COATED PARTICLE FUEL IRRADIATION IN DRAGON SECOND CHARGE. Part I. Preparation, Characterization, and Irradiation. Dragon Project. Beatty, R. L.; Bond, W. D.; Clinton, S. D. (Atomic Energy Establishment, Winfrith (England)). Feb 1969. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

Coated-particle fuel was assembled and irradiated in the Dragon Reactor. The general specifications of the coated particles are Sol-Gel thorium–uranium oxide kernels with thorium to uranium ratios of about 3.5 and 5, coated with two pyrocarbon layers. About 1,400 g of coated particles have been irradiated in the Dragon Reactor up to an average burn-up of 6.6 to 8.5% FIMA at temperatures up to 1300°C. Details are included on the preparation of the kernels, their coating, evaluation, and characterization. Since the irradiation experiment is still in progress, no results for solid fission product release or metallographic examination are given. (auth)

3025 (EUR-4946) DEPOSITION OF PYROLYTIC SILICON CARBIDE ON DISCS IN A FLUIDIZED BED. Erben, E.; Hausner, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50. EUR B.Fr. 50.-.

The chemical vapor deposition of pyrolytic silicon carbide on discs in a fluidized bed was investigated. The influence of the deposition conditions on density, microstructure, crystallite size, and chemical composition of the material was determined. Temperature and deposition rate had a strong influence on the structural appearance. (auth)

3026 (EURFNR-1032) RECOVERY PROCESSES IN THE OXYGEN SUBLATTICE OF QUENCHED AND NEUTRON-IRRADIATED URANIUM DIOXIDE. Vollath, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jun 1972. 45p. (KFK-1621). Dep. NTIS $5.45.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Recovery processes occurring in quenched and neutron-irradiated uranium dioxide in the temperature region between room temperature and 500°C are due to the migration of defects in the oxygen sublattice. Migration of uranium defects was not observed. Oxygen Frenkel defects are annealed at temperatures of about 400°C. This recovery step is found to be independent of specimen stoichiometry for irradiated and quenched samples. Recovery processes found in the temperature region between 150 and 250°C are characteristic of hyperstoichiometric material. (auth)

3027 (KFK-1726) TERNARY CARBIDES AND NITRIDES OF THE ACTINIDES AND LANTHANIDES WITH OTHER TRANSITION METALS. Holleck, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Dec 1972. 29p. (In German). (CONF-711075-1). Dep. NTIS (U. S. Sales Only) $3.50.

From conference on solid state chemistry; Vienna, Austria (11 Oct 1971).

The occurrence of ternary carbides and nitrides in systems between the actinide and lanthanide metals with the other transition metals is described. The formation of some of these compounds is to be expected to occur in highly burned carbide and nitride fuels. Connections between the occurrence and the structure of the compounds and the location of the metals in the periodic table can be given for the uranium compounds and for the perovskite carbides of the actinides and lanthanides with ruthenium and rhodium. Up to now, the reaction behavior of the other actinide or lanthanide carbides or nitrides with the transition metals is known for only some cases. (tr-auth)

3028 (N-72-33652) CALCULATION OF RADIATION-INDUCED SWELLING OF UN USING THE DIGITAL COMPUTER PROGRAM CYGRO 2. Davison, H. W.; Fiero, I. B. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Mar 1971. 15p. (NASA-TM-X-2224). NTIS.

Fuel volume swelling and clad diametral creep strains were calculated for five fuel pins, clad with either T-111 (Ta-8W-2.4Hf) or PWC-11 (Nb-1Zr-0.1C). The fuel pins were irradiated to burnups between 2.7 and 4.6%. Clad temperatures were between 1750 and 2400 F (1228 and 1589 K). The maximum percentage difference between calculated and experimentally measured values of volumetric fuel swelling is 60%. (auth)

3029 (ORO-4212-14) QUANTITATIVE DETERMINATION OF THE STRUCTURE–PROPERTY RELATIONSHIPS IN NUCLEAR FUEL ELEMENT MATERIALS. Quarterly Progress Report, October 1, 1972–December 31, 1972. Rhines, F. N.; DeHoff, R. T.; Whitney, E. D. (Florida Univ., Gainesville. Engineering and Industrial Experiment Station). Feb 1973. Contract AT(40-1)-4212. 37p. Dep. NTIS $4.00.

Activities in programs devoted to studies of relations between properties and microstructure of fuel element materials are summarized. Research on nickel powders and UO_2 is emphasized. Sections are included on nickel sintering and on structure of UO_2. (JRD)

3030 (SLA-73-5233) PULSED LASER-INDUCED VAPORIZATION OF GRAPHITE AND CARBIDES. Meyer, R. T. (Sandia Labs., Albuquerque, N. Mex.). 1973. 2p. (CONF-730601-1). Dep. NTIS $3.00.

Results of studies on the vapor compositions of graphite and metal carbides are presented. Data are given on the relative abundances of the vapor species from the following materials, heated both by a normal-mode laser and by a Q-switched laser: graphite, $TiC_{1.2}$, VC, Cr_3C_2, ZrC, NbC, Mo_2C, HfC, TaC, WC, and $UC_{2.2}$. (JRD)

3031 (SRARI-P-138) EXISTENCE OF NEPTUNIUM PROTOXIDE–OXIDE. Sudakov, L. V.; Solntsev, V. M.; Kapshukov, I. I.; Belyaev, Yu. I.; Chistyakov, V. M. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Methods of neptunium oxide production were studied. The oxide chemical compositions were determined by spectrophotometric titrating the oxide solutions in $HClO_4$, the phase composition being controlled by x-ray analysis. It is established that Np_2O_5 crystal lattice has an orthorhombic cell with a slight monoclinic distortion. According to the obtained data the existence of neptunium protoxide–oxide cannot at present be considered as having been proved. (auth)

3032 (SHARI-P-173) X-RAY ANALYSIS OF RADIATION DAMAGE IN NONMETALLIC MATERIALS. Kosenkov, V. M. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Main conclusions from theoretical works on x-ray scattering from imperfect crystals are reviewed briefly. Experimental results are compared with Krivoglaz' theoretical findings. The approach to the study of roentgenographic effects in irradiated nonmetallic substances is discussed. (23 references) (auth)

3033 (SRARI-P-163) MACROSCOPIC MODEL OF SWELLING OF IRRADIATED SOLIDS. Ivanov, L. D. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Irradiation-induced changes in volume of solids are considered by internal-stress theory. It is shown that the total effect is the sum of two components: elastic and inelastic ones. The former is due to arising internal stresses and the latter is caused by non-conservative dislocation movement. A formula for the relative change in volume was obtained which contains two parameters to be determined experimentally. The possibility of determination of these parameters by diffraction methods is shown. (auth)

3034 (TIM-767) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-41. Loethen, A. C.; Felber, F. F.; Frank, J. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 23 Sep 1963. 10p. Dep. NTIS.

Declassified 22 Oct 1971.

The irradiation behavior of Nb-1Zr alloy clad 50 vol % UO_2-BeO was studied and the fission gas and He release were measured as a function of burnup and time at a nominal clad surface temperature of 2200°F and a nominal power density of 1 kW/cc. The effects of test conditions on a nominal clad thickness of 15 mils and on the Nb-5Zr end plug welds were also studied. Comment and data based on post irradiation examinations are included. (JRD)

3035 (TIM-767(Suppl.1)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-42. Frank, J. E.; Felber, F. F. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 17 Oct 1963. 12p. Dep. NTIS.

Declassified 22 Oct 1971.

The irradiation behavior of Nb-1 Zr alloy clad 50 vol % UO_2-BeO was studied and the fission gas and He release was measured as a function of burnup and time at a nominal clad surface temperature of 2200°F and a nominal power density of 1 kW/cc. The effects of test conditions on a nominal clad thickness of 15 mils and on the Nb-5Zr end plug welds was also studied. Post-irradiation examination revealed that the fuel evolved as a mixture of fine UO_2 and BeO particles with some migration and agglomeration of UO_2 and BeO observed at the pellet periphery and at crack surfaces. No reduction or melting of the fuel occurred. (JRD)

3036 (TIM-769) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-15. Frank, J. E.; Felber, F. F. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 10 Oct 1963. 9p. Dep. NTIS.

Declassified 22 Oct 1971.

The irradiation behavior of Nb-1Zr alloy clad 50 vol % UO_2-BeO was studied and the fission gas and He release were measured as a function of burnup and time at a nominal clad surface temperature of 2000°F and a nominal power density of 1 kW/cc. Post-irradiation examination results are tabulated and discussed. (JRD)

3037 (TIM-769(Suppl.1)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-18. Frank, J. E.; Felber, F. F. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 17 Oct 1963. 8p. Dep. NTIS.

Declassified 22 Oct 1971.

The irradiation behavior of Nb-1Zr alloy clad 50 vol % UO_2-BeO was studied and the fission gas and He release were measured as a function of burnup and time at a nominal clad surface temperature of 2000°F and a nominal power density of 1 kW/cc. Results of post-irradiation examination are tabulated and discussed. (JRD)

3038 (TIM-788) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-150. Frank, J. E.; Felber, F. F.; Loethen, A. C. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 16 Dec 1963. 18p. Dep. NTIS.

Declassified 20 Oct 1971.

A study was conducted of the feasibility of using tantalum carbide, formed during test by the interaction of the tantalum barrier and the excess carbon in the UC fuel, as a protective barrier for the Nb-1 Zr alloy cladding. The irradiation behavior of hyperstoichiometric uranium carbide was also studied as a function of temperature, time, and burnup, at a nominal clad surface temperature of 2200°F, and a nominal power density of 1.5 kW/cc. The fission gas release was also studied as a function of these parameters. Post-irradiation examination results are tabulated and discussed. (JRD)

3039 (TIM-788(Suppl.1)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-150C. Frank, J. E.; Felber, F. F.; Loethen, A. C. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 16 Dec 1963. 11p. Dep. NTIS.

Declassified 20 Oct 1971.

A study was conducted of the feasibility of using tantalum carbide, formed during test by the interaction of the tantalum barrier and the excess carbon in UC fuel, as a protective barrier for the Nb-1Zr alloy cladding. Results of postirradiation examination are tabulated and discussed. (JRD)

3040 (TIM-855(Suppl.5)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-524. Carlson, C. E.; Felber, F. F. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 18 Jan 1965. 11p. Dep. NTIS.

Declassified 19 Oct 1971.

Capsule PW 26-524 contained a single test specimen with hyperstoichiometric UC fuel in tantalum-lined Nb-1Zr cladding. The specimen was irradiated at 2150°F for 549 hours to 0.63 at.% uranium fission burnup. Centerline melting occurred in the fuel between the top and middle pellets. Gas release data (1.8% Xe release) indicated that the melting was temporary and that it occurred early in the test. Excess carbon diffused to the pellet OD's and formed a continuous surface band, probably rich in U_2C_3. The fuel in the top pellet swelled 15 mils into the spacer area. Away from the melted area, porosity was 2 to 5%. Density change was: top pellet, -5.8%; middle pellet, -3.6%; and bottom pellet, -6.6%. Carbon penetrated through the tantalum barrier but did not diffuse into the cladding. Extensive grain growth occurred in the barrier and in the cladding adjacent to the fuel. The specimen operated at a power density of 1.5 kW/cc. Although the fuel melted in the center, and high cladding temperatures were achieved, the Ta barrier was effective in preventing reactions between the UC fuel and the niobium cladding. No carbide precipitates were observed in the cladding and fission gas release was commensurate with other UC irradiation tests under similar conditions. (auth)

3041 (TIM-855(Suppl.9)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-512. Loethen, A. C.; Ferry, H. W. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 20 May 1965. 3p. Dep. NTIS.

Declassified 19 Oct 1971.

A study was conducted of the irradiation behavior of uranium carbide clad in tungsten lined Nb-1Zr alloy tubing, operated at 2000°F in lithium at 0.40 kW/cc. Post test macroexamination revealed no leaks or anomalies in the outer can, inner can, or specimen container. All three fuel test specimens appeared dull metallic gray in the fueled area. The top test specimen appeared yellow in color for the top 1/4 of its length. This yellow color has been identified as ZrC and/or ZrN on previous specimens of this design. All three fuel specimens were recovered in excellent condition and maintained geometric integrity. (JRD)

3042 (TIM-855(Suppl.10)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-521. Loethen, A. C.; Ferry, H. W. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 21 May 1965. 3p. Dep. NTIS.

Declassified 19 Oct 1971.

The irradiation behavior of hyperstoichiometric uranium carbide fuel was studied in tantalum lined Nb-1Zr alloy cladding at 2200°F in lithium at a power density of 1.5 kW/cc. The relations between fuel swelling and gas release as a function of initial fuel density was determined. No leaks or anomalies were found in the outer can, inner can, or specimen container. The test specimen appeared to have remained leak-tight. The fueled area appeared dull metallic gray-black. Equiaxed grain structure approximately ASTM No. 4 was observed in the fueled area, and the average grain size in the spacer area of the specimen was approximately ASTM No. 6. Examination was performed at 30 x magnification. The top half of the specimen had a yellow coating resembling that previously identified as ZrC or ZrW. (auth)

3043 (TIM-855(Suppl.11)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-542. Loethen, A. C.; Ferry, H. W. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 2 Jun 1965. 3p. Dep. NTIS.

Declassified 19 Oct 1971.

The irradiation behavior of hyperstoichiometric uranium carbide, clad in tantalum lined Nb-1Zr-0.1C (PWC-11) alloy tubing when operated at 2200°F in lithium at 0.40 kW/cc was studied. The fuel test specimen was subjected only to macroexamination and diametral measurements, because the solution heat treatment given the PWC-11 alloy in this capsule resulted in a very low rupture ductility. In addition, it has been found that the tantalum liner removes significant amounts of carbon from the PWC-11 alloy thereby altering its composition. Another reason for limiting the examination of this capsule is that, because of a heater failure, the test duration was short compared with the 10,000 hour

required life. Post-irradiation results are tabulated and discussed. (JRD)

3044 (TIM-855(Suppl.12)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-550. Loethen, A. C.; Ferry, H. W. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 2 Jun 1965. 4p. Dep. NTIS.

Declassified 19 Oct 1971.

The irradiation behavior of uranium carbide, clad in tungsten- or tantalum-lined Nb-1Zr-0.1C (PWC-11) alloy tubing, operated at 2200°F in lithium at 0.40 kW/cc was studied. The fuel test specimen was subjected only to macroexamination and diametral measurements, because the solution heat treatment given the PWC-11 alloy in this capsule resulted in a very low rupture ductility. In addition, it has been found that the tantalum liner removes significant amounts of carbon from the PWC-11 alloy thereby altering its composition. Another reason for limiting the examination of this capsule is that, because of a heater failure, the test duration was short compared with the 10,000 hour required life. Post-irradiation examination results are tabulated and discussed. (JRD)

3045 (TM-61-10-3) TESTING OF FUELED BeO AT HIGH PRESSURE IN FIVE DIFFERENT ENVIRONMENTS. Turner, P. P. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 26 Oct 1961. Contract AT(40-1)-2847. 19p. Dep. NTIS.

Declassified 3 Nov 1971.

The testing of BeO fueled with 10 wt % UO_2, added as 45 wt % UO_2-55 wt % Y_2O_3, in environments of air, N_2, CO_2, He, and air-He at 300 psi is described. Tests were run for 25 hours at 2000 and 2500°F using each of these environments. The results showed overall physical integrity to be excellent, the primary change being the general loss (4 to 41%) of strength depending on the test condition used. (auth)

3046 (TM-62-1-7) ELECTRON MICROSCOPY OF SOL PARTICLES. Rau, R. C. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Jan 1962. Contract AT(40-1)-2847. 15p. Dep. NTIS.

Declassified 3 Nov 1971.

A limited amount of electron microscopy has been performed to aid in the study of the characteristics of various sols containing ceramic particles of colloidal size. Although no definite conclusions can be drawn from such a brief examination, a presentation of techniques and methods used, as well as electron micrographs obtained, was felt useful. By suitably diluting and drying the original sols, electron microscope specimens have been prepared from which images of ZrO_2, Al_2O_3, and UO_2 sol particles at magnifications up to 150,000 times have been obtained. These electron micrographs show external shapes as well as much of the internal structures of the particles. It is felt that the present capabilities of this method of structural examination are limited only by the inherent limitations of the electron microscope available. (auth)

3047 (TM-62-11-7) GE-NMPO CLASSIFIED CONTRIBUTION TO 15TH HIGH TEMPERATURE FUELS COMMITTEE MEETING. Aitken, E. A.; Brassfield, H. C. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 1962. Contract AT(40-1)-2847. 29p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of research on physical, chemical, and mechanical properties of Y_2O_3-containing UO_2 fuels are summarized. Results of tests of thermal and irradiation stability are also included along with research results on stability of fuel element materials in nonoxidizing atmospheres at temperatures higher than 1900°C. (JRD)

3048 (TM-63-6-2) ZIRCONIUM HYDRIDE IRRADIATION $LTZH_x$ - 2. Elkins, J. D. (Oak Ridge National Lab., Tenn.). May 1963. Contract AT(40-1)-2847. 15p. Dep. NTIS.

Declassified 4 Nov 1971.

A test was conducted to determine the integrity of unclad zirconium hydride moderator specimens under radiation at 1300°F for 1000 hours and to determine the effects of carbide and boride additives on the integrity of the material. Photographs are included to illustrate damage. An exothermic reaction occurred; the reaction started at about 1000°F. The maximum unperturbed thermal neutron flux in the C-45 facility was found to be 4.36×10^{13} nvt. (JRD)

3049 (TM-63-6-7) COATED FUEL PARTICLE DEVELOPMENT AND EVALUATION. Latta, R. E.; Browne, C. C. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). May 1963. 21p. (CONF-273-2). Dep. NTIS.

From fifth meeting of the coated particle fuels working group; Cincinnati, Ohio, USA (Jun 1963).

Results of research on preparation of coated fuel particles and fabrication of fuel elements are summarized. Information is included on fuel particle spheroidization using plasma, comminution of UO_2-Y_2O_3-ZrO_2 compositions, and coating of spherical fuel particles. (JRD)

3050 (TM-63-6-8) INCORPORATION OF FUELED SPHERES IN A BERYLLIA MATRIX. Joseph, R. A. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). May 1963. Contract AT(40-1)-2847. 11p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of research on preparation of fuel spheres incorporating UOX grade BeO matrix are summarized. Information is included on mixing, extrusion, and densification of the fuel. An evaluation of the fuel is also included. (JRD)

3051 (TM-63-6-16) IRRADIATION OF A BeO BASE FUEL CONTAINING Gd_2O_3 AS A BURNABLE POISON. Elkins, J. D. (Oak Ridge National Lab., Tenn.). 28 May 1963. Contract AT (40-1)-2847. 22p. Dep. NTIS.

Declassified 4 Nov 1971.

Results of tests to evaluate Gd_2O_3 as a burnable poison in BeO-base fuel elements are presented. The tests were conducted for about 2 weeks at a maximum fuel element temperature of 2500°F. Most of the Gd_2O_3 was lost during the irradiation. (JRD)

3052 (TM-65-4-22) REFRACTORY METAL FUEL ELEMENT IRRADIATION. Test Operating Report LTFF-9. Blevins, R. E. (Oak Ridge National Lab., Tenn.). Mar 1965. Contract AT(40-1)-2847. 27p. Dep. NTIS.

Declassified 4 Nov 1971.

Results are presented of tests to determine the stability of W-Re-Mo alloy clad UO_2-ThO_2-W fuels irradiated at about 2000° in the Low Intensity Test Reactor. (JRD)

3053 (TM-66-3-18) REFRACTORY METAL FUEL ELEMENT IRRADIATION. Test Operating Report LTFF-11. Blevins, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation; Oak Ridge National Lab., Tenn.). 2 Mar 1966. Contract AT(40-1)-2847. 27p. NTIS.

Declassified 4 Nov 1971.

Results are presented of tests to determine the stability and fission product retention in W-Re-Mo alloy clad UO_2-W-ThO_2 fuel elements irradiated at 3000°F in the Low-Intensity Test Reactor. (JRD)

3054 (TM-67-3-6) TEST OPERATING REPORT LTFRY-1. Blevins, R. E. (Oak Ridge National Lab., Tenn.). Feb 1967. Contract AT(40-1)-2847. 21p. Dep. NTIS.

Declassified 3 Nov 1971.

Results of irradiation testing of Mo-Re alloy clad fuel elements are presented. The irradiation test was conducted at a maximum temperature of 1560°F for 1000 h. Results are tabulated. (JRD)

3055 LONG-RANGE ORDERING IN MAGNETICALLY DILUTED EUROPIUM HEXABORIDE. Krause, J. L.; Sienko, M. J. (Cornell Univ., Ithaca, NY). J. Solid State Chem.; 6: No. 4, 590-594(Apr 1973).

Magnetic susceptibilities of the compounds $Eu_xYb_{1-x}B_6$ were measured by the Faraday method over the range 1.7 to 300°K. The susceptibilities follow a Curie-Weiss law with an effective magnetic moment of 8 μ_B per europium. Weiss constants are 8.8, 7.0, 4.9, 3.6, 2.0, 0.0, and 0.0 ± 0.3°K for x values of 1.0, 0.8, 0.6, 0.4, 0.3, 0.2, 0.1, respectively. Corresponding ferromagnetic Curie temperatures are 8.4, 7.1, 4.6, 1.5, 0.0, 0.0, and 0.0 ± 0.2°K. Comparison of the change in Curie temperature with that expected by various theories of magnetic dilution suggests that the exchange mechanism involves nearest-neighbor interactions only. (auth)

3056 LATTICE PARAMETERS AND SPACE GROUP OF $Ce(MoO_4)_2$. Brixner, L. H.; Whitney, J. F.; Licis Kay, M. S. (E. I. du Pont de Nemours and Co., Wilmington, DE). J. Solid State Chem.; 6: No. 4, 550-552(Apr 1973).

The compound was prepared in single-crystal form by the Czochralski technique. Precession x-ray work indicated triclinic symmetry with either 1 or $\bar{1}$ as space group. A second harmonic generation test was negative and therefore strongly suggests $\bar{1}$ as the proper space group for $Ce(MoO_4)_2$. The refined cell dimensions were found to be: a = 10.150 ± 2 Å, b = 18.442 ± 3 Å, c = 9.559 ± 2 Å, α = 96.76 ± 1°, β = 101.91 ± 1°, and γ = 103.96 ± 1°. (auth)

3057 MATERIAL TRANSPORT BY DISLOCATION MOTION IN SINTERING. Morgan, C. S. (Oak Ridge National Lab., TN). Phys. Sintering; 5: No. 1, 33(Jan 1973).

Some aspects of sintering mechanisms in refractory materials are considered. Densification kinetics occurring as the temperature of the sintering compact is being increased are not compat-

ible with a diffusion-controlled process. A possible alternative mechanism compatible with the densification kinetics is dislocation slip. Dislocations created during short high-temperature excursions are observed by electron transmission microscopy in partially sintered compacts of MgO and tungsten. The dislocations appear to contribute to the material transport process and support the probable importance of dislocation slip in sintering of fine particle powders. (auth)

3058 MASSIVE METAL HYDRIDE STRUCTURES AND METHODS FOR THEIR PREPARATION. Van Houten, R. U. S. Patent 3,720,752. 13 Mar 1973. Filed date 11 Apr 1967. 12p.

A method is given for preparing thermally and chemically stable, crack-free massive metal hydride (deuteride, tritide) structures for shielding and moderator use in reactors. The incidence of cracking is reduced by dispersing a grain-growth inhibitor (C, graphite, B) in the metal for the hydridation reaction. Besides Zr, whose hydrides were prepared in crack-free form, stable hydrides of Ti, Hf, Y, Th, V, Nb, Ta, and other metals and alloys can also be prepared in this way. Other ways of producing grain growth-inhibitor are described. (DLC)

3059 DEFECT STRUCTURE OF PURE AND CALCIA-DOPED NONSTOICHIOMETRIC CERIUM DIOXIDE. Panlener, R. J. Milwaukee; Marquette Univ. (1972). 191p. University Microfilms Order No. 73-8295.

Thesis (Ph. D.)

Thermogravimetric measurements were performed on nonstoichiometric CeO_2 in the temperature range 700 to 1500°C and from oxygen pressures of 10^{-1} to 10^{-28} atm. From this data the deviation from stoichiometry $x = x(T,P_{O2})$ for CeO_{2-x} was determined. Similar measurements were performed on CeO_2 doped with 1 and 7 mole % CaO from 800 to 1200°C and from 10^{-5} to 10^{-29} atm of oxygen. The quantities $\Delta\bar{H}_{O_2}$ and $\Delta\bar{S}_{O_2}$ were calculated from $0.0003 \leq x \leq 0.3$ for CeO_{2-x} and found to be temperature-independent in the range of this investigation. The values for $x < 0.15$ compare favorably with those of Bevan and Kordis obtained in a lower temperature range. However, the values differ for $x > 0.15$. The addition of calcia to CeO_2 changes the P_{O_2} dependence of the thermogravimetric data to $P_{O_2}^{-1/4}$ over an appreciable range of composition. This behavior is shown to be consistent with the proposed oxygen-vacancy-defect model for the undoped CeO_2. From a combination of thermogravimetric and electrical conductivity data, the electron mobility for $CeO_{1.998}$ was calculated to be $\approx 10^{-2}$cm^2/V-sec. The mobility exhibits an exponential temperature dependence between 700 and 1300°C with an activation energy of 0.23 eV, and is consistent with the assumption of localized electrons and a "hopping-type" conduction process in CeO_{2-x}. (DLC)

3060 IONIC CONDUCTIVITY OF PURE AND CALCIA-DOPED CERIUM DIOXIDE. Van Handel, G. J. Milwaukee; Marquette Univ. (1972). 170p. University Microfilms Order No. 73-8303.

Thesis (Ph. D).

An oxygen concentration cell of the type P_{O_2}, Pt/oxide electrolyte/Pt, P'_{O2} was used to measure ionic transference fractions of pure and CaO-doped CeO_2 electrolytes. These tranference fractions when combined with measurements of the total electrical conductivity yielded ionic and electronic conductivities from 700 to 1000°C and from 1 to 10^{-22} atm of oxygen for pure CeO_2 and CeO_2 doped with 2, 5, 8, and 14 mole % CaO. (DLC)

3061 STRUCTURE OF SELECTED RHOMBOHEDRAL BORIDES. Novak, R. D. Urbana, IL; Univ. of Illinois (1972). 120p. University Microfilms Order No. 73-10,015.

Thesis (Ph. D.).

The structures of rhombohedral boron carbide, arsenide, phosphide, and sulfide were analyzed on the basis of existing x-ray-intensity data. A least-squares refinement program was used to calculate the atomic positional parameters associated with each structure, and calculations were made of the interatomic distances within the structure. In addition, x-ray-intensity data along with density and chemical data were collected for rhombohedral boron carbide and rhombohedral boron oxide. Structural analysis of the carbide data indicated close agreement with previous structural analysis of this material. Evaluation of the rhombohedral boron oxide data showed that the oxide was a member of the rhombohedral series of borides and structural parameters and interatomic distances were derived using a least squares refinement technique. All of the borides studied were derived from alpha-rhombohedral boron. The variable composition of the borides was explained as nonstoichiometry on crystallographic sites which correspond to interstitial holes in the icosahedral network of alpha-rhombohedral boron. (Diss. Abstr. Int., B)

3062 BORONIZING OF THE CARBIDE CONSTITUENTS OF HARD ALLOY TOOLS. Kolosvetov, Yu. P.; Navrotskii, B. S.; Zhunkovskii, G. L. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 12, 1015-1017(Dec 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 12, 84-86(Dec 1972).

A study was made of the reactions of tungsten carbide and titanium carbide with boron. The temperature dependence of the rate of boronizing and the phase compositions of the resultant reaction products were determined. It is shown that, during the impregnation of a hard-alloy tool with boron, the latter reacts with the tungsten carbide as well as with the cobalt binder. (auth)

3063 WEAR-RESISTANT MATERIALS FOR PRESSING FERRITE PARTS. Koval'chenko, M. S.; Sereda, N. N.; Ostroverkhov, V. I.; Belik, I. T. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 12, 993-994(Dec 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 12, 57-58(Dec 1972).

A new hard alloy material based on titanium carbide with a nickel–molybdenum binder was developed. A trial batch of titanium carbide–nickel–molybdenum cermet die sets was manufactured and tested under conditions of compaction of ferrite components. Being nonmagnetic, the new die set strengthening material can be employed in the pressing of anisotropic barium magnets in a magnetic field. The useful life of a die set with inserts made in the new cermet is, by and large, equal to that of die sets with VK hard alloy inserts, occasionally exceeding it by 4.5 to 5%. Even at the same life, use of the new cermet reduces tool material costs in the pressing of ferrite parts by a factor of eight. (auth)

3064 PROTECTIVE SHEATHS OF THERMOCOUPLES FOR AUTOMATIC THERMAL CONTROL OVER METALLURGICAL PROCESSES. Kislyi, P. S.; Kuzenkova, M. A.; Struk, L. I., Morgunovskaya, B. A.; Zvazhenko, V. K.; Bol'shechenko, A. G.; Ostroverkhov, V. I. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 12, 987-992(Dec 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 12, 49-56(Dec 1972).

A technique was developed for the manufacture of protective thermocouple sheaths from zirconium diboride–tungsten alloys. A study was made of the charge plasticizing characteristics of various substances, and die extrusion was chosen as the most suitable sheath shaping process. On the basis of data yielded by investigations into sintering kinetics and the process of alloy structure formation in various atmospheres, the optimum sheath sintering parameters were determined. Some properties of sheaths and results of tests on sheaths exposed to molten cast iron and steel are given. 5 figures, 2 tables, 17 references. (auth)

3065 SINTERING OF NONSTOICHIOMETRIC UO_2 UNDER NONISOTHERMAL CONDITIONS. Uskokovic, D.; Djuricic, L. J.; Zivanovic, B.; Ristic, M. M. (Institut za Nuklearne Nauke Boris Kidric, Belgrade). J. Mater. Sci.; 8: No. 4, 539-544(Apr 1973).

The sintering kinetics of nonstoichiometric uranium dioxide powders were studied in the temperature range 700 to 950°C. Results of the relative linear shrinkage during the stepwise heating of samples were analysed as a function of sintering temperature and time. It was shown that it is impossible to explain the exceptionally large shrinkage of UO_{2+x} compacts in the temperature range 0.3 to 0.4 T_m by means of a single sintering mechanism. (auth)

3066 ANOMALOUS TEMPERATURE DEPENDENCE OF THE MOBILITY OF OXYGEN IN MOLYBDENUM OXIDE. Muzykantov, V. S.; Cheshkova, K. Ts.; Boreskov, G. K. (Inst. of Catalysis, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 207: No. 2, 374-376(11 Nov 1972). (In Russian).

The self-diffusion rate of oxygen in MoO_3 was studied through the isotopic exchange of the O in MoO_3 with that in CO_2 in which the isotope ^{18}O had been enriched to 50 at. %. The temperature dependence of the rates of all oxygen exchange processes investigated failed to conform to the Arrhenius equation. Since corresponding data differed sharply when compared at 480 and 510°C, it was concluded that some kind of transformation occurred in MoO_3 at or near 500°C. (KSW)

3067 HYPERFINE SPLITTING IN V_3O_5 MEASURED BY INELASTIC NEUTRON SCATTERING. Heidemann, A. (Technische Univ., Munich). Phys. Status Solidi (a); 16: No. 2, K129-K132(16 Apr 1973).

An attempt was made to measure directly the hyperfine field at the V nucleus in V_3O_5 using inelastic spin–flip scattering of neutrons. The spectrum at 10°K shows three peaks (one elastic

and two inelastic). The line splitting $\delta E = 0.68\ \mu$ eV gives an internal hyperfine field of 146 ± 6 kOe. V_3O_5 is seen to possess magnetic order at 10°K, in agreement with Okinaka's Moessbauer study. (DLC)

3068 PLASTICITY OF TUNGSTEN CARBIDE. Johannesson, T. (Sandvik AB Coromant Research Center, Stockholm); Lehtinen, B. Phys. Status Solidi (a); 16: No. 2, 615-622(16 Apr 1973).

WC grains in a cemented carbide grade containing 15% Co were studied by transmission electron microscopy. Dislocation networks specific to WC were found. They consist of interlinked extended rectangular nodes, which are believed to be sessile, thus anchoring the networks. The networks in deformed WC crystals show bowed-out dislocation links. The observed networks are considered to account partly for the specific mechanical properties of WC. (auth)

3069 TUNGSTEN: THE VERSATILE HEAVY. Parks, J. W. Precis. Metal; 30: No. 12, 44-45(Dec 1972).

The high melting point and density of W make it suitable for parts such as rod mill rolls, induction furnace heating elements, and counterweights. Recommendations for preparing rod and wire from powder, sintering, producing large parts in isostatic presses, and working pressed and sintered W-stock are given briefly. (Metals Abstr.).

3070 PROSPECTS FOR THE DEVELOPMENT OF COMMERCIALLY USEFUL FIBER-REINFORCED HIGH-TEMPERATURE (RESISTANT) METALLIC MATERIALS. Elssner, G. Z. Werkstofftech.; 2: No. 7, 337-345(1971). (In German).

High-temperature material applications are briefly outlined and the development of metal/ceramic composite materials technology is reviewed. For temperatures <1200°C Ni superalloys (e.g., 80:20 Ni–Cr) are used as the metal matrix with Al_2O_3 whisker reinforcement. For temperatures >1200°C, a Nb, Mo, Ta, or W matrix is employed, usually incorporating SiC-fiber reinforcement. Production methods are discussed and problems of fiber matrix compatibility and oxidation resistance are considered. Comparisons of a number of fiber/matrix combinations are made and discussed. (30 references) (Metals Abstr.)

3071 INVESTIGATIONS ON THE URANIUM–NITROGEN SYSTEM. Reuter, H. Mainz; Mainz Univ. (1971). 175p. Library, Mainz Univ. (In German).

Thesis (Ph.D.).

The reaction of uranium metal powder with nitrogen was investigated in the temperature range of 400 to 1,150°C and under a pressure of 1 atm. Also, nitriding under reduced pressures of 10 to 420 torr between 1,000 and 1,150°C were carried out. Compact uranium metal samples were nitrided at temperatures between 1,000 and 1,400°C under 1 atm pressure nitrogen. The conditions for the preparation of pure hexagonal $\beta-U_2N_3$ were investigated, and experiments to obtain UN_2 under pressure were carried out. By nitriding UN, $\beta-U_2N_3$, and $\alpha-U_2N_3$ at temperatures between 376 and 570°C with nitrogen pressures up to 212 atm, nitrides were obtained with the composition $UN_{1.83}$. By nitriding UN at 430°C with ammonia under an equilibrium pressure of 210 atm, a nitride with the composition $UN_{1.86}$ was prepared. UN_2 could not be prepared under these conditions. The temperature of formation of the β phase from U_2N_3 from the α phase was determined by means of differential thermal analysis in a nitrogen atmosphere at a defined pressure (1 atm). The composition of the yielded nitrides, their properties, and their structures were investigated. This is followed by a study of the corrosion behavior of uranium metal with quartz at high temperature. (GF)

3072 PRODUCTION OF LARGE-SIZED LANTHANUM HEXABORIDE PARTS. Kuznetsova, G. M.; Kudintseva, G. A.; Likhacheva, T. K.; Suchkov, L. K. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 10, 810-814(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 46-51(Oct 1972).

A series of experiments was carried out to develop a production technique for large-size disks made of lanthanum hexaboride. The molding and sintering conditions are worked out. It is established that when producing articles of LaB_6 by means of cold molding it is necessary to use the method of activated sintering with introduction of 1.5 to 2.0% by weight of platinum- or nickel-group metals as activating additives to lower the sintering temperature. Application of activating additives in hot molding is shown to be practically inexpedient. (auth)

3073 IMPROVEMENTS IN OR RELATING TO A METHOD OF APPLYING A CLADDING TO NUCLEAR FUEL ARTEFACT. Wheatley, C. C. H.; George, D. (to United Kingdom Atomic Energy Authority). British Patent 1,303,052. 17 Jan 1973. Filed date 1 Jul 1969. 3p.

The method described is particularly applicable to UC fuels. The thermal conductivity of this material is so high that its temperature is close to that of the coolant unless special expedients are adopted, such as the interposition of an insulating layer between the fuel surface and the surface of the can. The method of forming this insulating layer comprises laying upon a mandrel at least one layer of a flexible film of insulating material, treating this film so as to give a self-supporting cladding, withdrawing the mandrel and replacing it by the nuclear fuel artefact to be clad, and then sintering the cladding. The dimensions of the mandrel relative to the fuel to be clad are such that the shrinkage of the cladding on sintering is such as to cause it to shrink firmly on to the fuel artefact. The flexible film may be formed by sintering from powder mixed with a binder. The binder may be a thermoplastic or thermosetting resin. Suitable cladding materials are Cu, Ni, Fe, Zr, and alloys such as steel or zircaloy or oxides or carbides of U, Zl, Zr, and Be in powder form. Si may also be employed, converting to nitride by sintering in a N_2 atmosphere. Examples are described using UO_2 as the insulating flexible film material and UC as fuel material. The fuel rod made as described is finally inserted into the fuel can. (UK)

3074 REACTION BEHAVIOR OF SUPERSATURATED (TUNGSTEN, TITANIUM, TANTALUM) CARBIDES IN LIQUID COBALT. May, W. (Krupp (Friedr.) GmbH, Essen). Tech. Mitt. Krupp, Forschungsber.; 30: No. 1, 15-48(1972). (In German).

Thesis.

Structural composition of (W, Ti, Ta)C–Co alloys, analysis of the boundary phase, and nuclear phase of the mixed carbide grain during the preparation of the sintered compact from the key alloys are given. Qualitative significance of the inhomogeneity of the mixed carbide grain was studied. Discontinuous decomposition, segregation, and grain growth of supersaturated (W, Ti)C–mixed crystals with and without bonding metal components are discussed. The time and temperature dependence of the segregation process and grain growth (Ostwald ripening) were determined. The various conversion constants of both processes are discussed. (GF)

3075 CRYSTAL STRUCTURE OF URANIUM OXIDES. Masaki, N. (Japan Atomic Energy Research Inst., Tokai). Nippon Genshiryoku Gakkaishi; 15: No. 1, 27-36(Jan 1973). (In Japanese).

In the region UO_2-UO_3, there exist many kinds of uranium oxides—UO_2, U_4O_9, U_3O_7, U_3O_{13} (or U_2O_5 or U_8O_{21}), U_3O_8, and UO_3—with somewhat wide ranges of nonstoichiometry, as expressed by UO_{2+x}, U_4O_{9-y}, U_3O_{8-z}, and $U_3O_{13\pm v}$. The information available to date on the crystal structure of uranium oxide is reviewed and assessed chiefly from the viewpoint of superstructure and nonstoichiometry. (auth)

3076 SINGLE CRYSTALS OF REFRACTORY COMPOUNDS: A REVIEW. Part II. Andrievskii, R. A.; Rymashevskii, G. A.; Sinel'nikova, V. S. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 10, 796-809(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 30-45(Oct 1972).

Mechanical properties (slip systems, anisotropy, elasticity, shear stress, dislocation structure, plastic deformation), electrophysical characteristics (resistivity, Hall effect, heat and mass transfer, diffusion) were considered in single crystals of refractory compounds. It is shown that the study of the properties in single crystals, besides specification of physico-chemical and mechanical parameters, results in a more profound comprehension of the mechanism of admixture effect on properties of refractory compounds and the elucidation of their nature. (10 figures, 7 tables, 89 references) (auth)

3077 VANADIUM–IRON OXIDE CATALYSTS FOR PARTIAL OXIDATION. I. The Phase Composition of the System $V_2O_5-Fe_2O_3$. Kurina, L. N.; Edíseeva, O. N. (Tomsk State Univ., USSR). Kinet. Katal.; 14: No. 1, 267-270(1973). (In Russian).

The phase composition of the $V_2O_5-Fe_2O_3$ system was investigated by x-ray diffraction, thermogravimetric techniques, ir-spectroscopy, and electrical conductivity. The catalytic mixture was prepared by evaporating a mixture of the aqueous solutions of ammonium metavanadate and ferric nitrate, and subsequently decomposing the salts at 450°C. The formation of the compound $FeVO_4$ and of a solid solution in the region 0 to 25% Fe_2O_3 were detected. (KSW)

3078 ELECTROPHYSICAL PROPERTIES OF TiC–Nb, TiC–Ta, TiC–Mo, AND TiC–W CERMETS. Samsonov, G. V.; Bogomol, I. V.; L'vov, S. N.; Lesnaya, M. I. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 10, 824-828(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 62-67(Oct 1972).

A study was made of the effect of temperature, in the range 20 to 1100°C, on the electrical resistivity and thermo-emf of TiC–Nb, TiC–Ta, TiC–Mo, and TiC–W cermets with metal-to-carbide ratios of 25 : 75, 50 : 50, and 75 : 25 at. and mole %, and their Hall constants at 20°C were determined. It was established that the property vs composition curves exhibit extreme points at 50 at. % Nb and Ta and 25 at. % Mo and W. The plots of ρ vs t and α vs t obtained for these cermets were found to be straight lines, demonstrating that their conductivity has a metallic character. The electrical resistivity of the TiC–Nb and TiC–Ta cermets investigated is seven to fourteen times that of the starting metals (16 for Nb and 14.7 $\mu\Omega$-cm for Ta) and two to four times that of titanium carbide (53 $\mu\Omega$-cm). The electrical resistivity of cermets of the systems TiC–Mo and TiC–W is one order higher than that of the starting metals and up to three times higher than that of titanium carbide, the only exceptions being 25 TiC–75 Me^{II} cermets (where Me^{II} is Mo or W), whose electrical resistivity is slightly less than that of titanium carbide. (auth)

3079 COMPATIBILITY OF BORON FIBER WITH A TUNGSTEN SUBSTRATE AND A TITANIUM MATRIX. Burykina, A. L.; Dzyadykevich, Yu. V.; Gorskii, V. V. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 900-903(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 48-53(Nov 1972).

B fibers were produced by depositing B on thin W filaments. Composites were produced by hot pressing the B fibers with Ti powder. The reaction of B fibers with the W cores was studied at 1100°C, and that with the Ti matrix at 900 to 1300°C; the time of reaction was varied from 1 to 10 h. Metallography, x-ray phase and electron microprobe analyses, and microhardness were used. Results for the fibers show the following intermediate phases: W_2B, WB, W_2B_5, WB_4, and probably WB_{12}. Thus, W is not a satisfactory substrate for B fibers. For the composite, no sign of reaction at the B/Ti interface was detected. The fiber began to react with the matrix at 900°C, but the thickness of the resulting layer did not exceed 1 μ. Above 1100°C, a layer resembling a solar corona appeared; its microhardness suggests that it is TiB. Electron microprobe results indicate the formation of two annular layers of Ti_2B and TiB + TiB_2. Growth of the diffusion layer at 900 to 1300°C follows the equation $K = 7.4 \exp(-27{,}600/RT)$ cm/h. (DLC)

3080 SPECTROSCOPIC INVESTIGATION OF THE REACTION OF OXIDES WITH METALLIC SURFACES. III. Systems Al_2O_3–Me(Al, Cu, Ti, 18/9/Ti Steel, Ni, Co, Mo, W, Si). Karpinos, D. M.; Aivazov, V. Ya.; Listovnichaya, S. P. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 904-906(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 54-57(Nov 1972).

Al_2O_3 films were deposited on metal plates and then annealed at 600 to 1600°C. Changes in the infrared spectra were measured. The main difference between the spectra of Al_2O_3 films on metallic substrates and bulk Al_2O_3 is that the former exhibit an additional band at ~1000 cm^{-1}. After annealing above 1000°C, bands at 442, 578, 637, and 500 cm^{-1} appear; all these except the last one are found also in the spectra of a corundum single crystal when the electric radiation vector is $\perp$ to the C-axis, indicating that the annealed film is texturized so that some of the C axes are parallel to the substrate plane. The refractive index increases with annealing temperature above 1000°C, attaining the corundum value of 1.75. It is concluded that annealing above 1000°C induces the $\gamma \rightarrow \alpha$-$Al_2O_3$ transformation. The cause of the additional bands at ~1000 and 500 cm^{-1} is discussed; the 1000-cm^{-1} band is probably due to the polarizing action of the metallic substrate. (DLC)

3081 THERMAL CONDUCTIVITY OF CERMETS CONTAINING TITANIUM CARBIDE. Samsonov, G. V.; Bogomol, I. V.; L'vov, S. N.; Lesnaya, M. I. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 910-912(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 62-65(Nov 1972).

The thermal conductivity of TiC–Nb, TiC–Ta, TiC–Mo, and TiC–W cermets with metal contents of 25, 50, and 75 at. % was investigated at temperatures ranging from 20 to 1100°C. The thermal conductivity of the cermets was found to be much less than that of their metallic constituents. It was established that, at constant temperature, the thermal conductivity of the cermets increases in the order TiC–Nb < TiC–Ta < TiC–Mo < TiC–W. (auth)

3082 MAGNETIC PROPERTIES OF CARBIDES OF THE TRANSITION METALS. Grebenkina, V. G. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 918-922(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 73-78(Nov 1972).

Regularities in the magnetic susceptibility of the Group IV–VI metals and their carbides are listed. The diamagnetic and paramagnetic components and the effects of electronic structure and carbide composition on the susceptibility and its temperature dependence are discussed. The Curie–Weiss law is not obeyed by the metals, indicating that there are no localized moments and that the magnetic properties are determined by the conduction electrons. The sign of the differential temperature coefficient is related to the position of the Fermi level as a function of the degree of filling of the M–M band. The temperature coefficient of TaC_x susceptibility changes from positive to negative with x due to the effective mass of the carriers. 16 references. (DLC)

3083 MEASUREMENT OF THE EMISSIVITY OF MATERIALS PRODUCED BY POWDER AND PLASMA METALLURGY TECHNIQUES. Smirnov, E. V. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 923-927(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 79-84(Nov 1972).

Emissivity measurements are reported for a hollow cylinder of BeO–30% Mo and for plasma-sprayed coatings of Al_2O_3, FeO (formed from Fe_2O_3), ZrO_2, Si, NbC, and NbC–10% Cu. Estimates of the error are made and the methods discussed. (DLC)

3084 EFFECT OF COBALT CONTENT ON THE TENSILE STRENGTH OF WC–Co HARD ALLOYS. Ivensen, V. A. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 928-933 (Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 85-92(Nov 1972).

The relation between the strength (tensile and bend) of WC–Co hard alloys and the Co content typically shows a maximum at some Co content. The relation is analyzed using a schematic model which represents a hard alloy as two separate (interlinked) carbide and cobalt skeletons. It is possible to describe quantitatively the relation by considering the link between the "load-carrying capacity" of the Co phase and the strength of the carbide skeleton. (DLC)

3085 CALCULATION OF THE THERMODYNAMIC PROPERTIES OF OXIDES, CARBIDES, AND NITRIDES OF TI AND V ON THE BASIS OF THE CLUSTER MODEL. Kamyshov, V. M.; Gorbatov, A. G.; Men, A. N. (Sverdlovsk Inst. of National Economy, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1468-1469(Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1671-1672(Sep 1972).

In the cluster model, variable-composition compounds AB_x are regarded as solutions of noninteracting components. An equation is given and a graph is plotted for the activity of TiO_x and VO_x. Isobaric potential and entropy values are tabulated for the formation of TiO_x (x = 0.85 to 1.20), VO_x (0.99 and 1.11), TiC_x (0.62 to 0.82), TiN_x (0.64 to 0.80), $VN_{0.956}$, and VC_x (0.69 to 0.88). (DLC)

3086 EFFECTS OF ALKALINE EARTH OXIDES ON THE OPTICAL AND EPR SPECTRA OF IRRADIATED ALKALI SILICATE GLASS. Brekhovskikh, S. M.; Viktorova, Yu. N.; Tyul'kin, V. A. Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1456-1460 (Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1659-1664(Sep 1972).

The concentration and type of alkaline earth oxide affects the optical and EPR spectra of gamma-irradiated glasses with the composition 18 mole % Na_2O–82% SiO_2. The alkaline earth oxides were added by equimolar replacement of silica. The spectral changes due to the presence of MO differ from those occurring in the presence of equivalent amounts of M_2O. There is an anomalous change (a rapid drop) in the additional optical absorption in the visible region and in the paramagnetic absorption in the region g = 2.01 on the addition of a high MO concentration to the original glass (25 mole % CaO, 35% SrO, 25% BaO). If the content of alkaline earth oxide is below these values, the spectra of glasses from the system Na_2O–MO–SiO_2 are similar, but are not a superposition of the spectra of the glasses $Na_2O \cdot SiO_2$ and $MO \cdot SiO_2$. (auth)

3087 RADIATION DAMAGE IN OXIDES. 1. Defect Formation in MgO. Tench, A. J.; Duck, M. J. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Phys., C (London); 6: No. 7, 1134-1148(12 Apr 1973).

Kinetics of vacancy production were studied in high-purity MgO powders after irradiation by 20-MeV protons. The rate of formation of cation vacancies fits a model of interstitial–vacancy recombination and indicates an approach to saturation at concentrations of about 10^{18} vacancies cm^{-3} which is comparable with impurity-induced levels in many crystals. Isochronal annealing

curves show that the cation vacancy is destroyed over a narrow temperature range between 650 and 700°K. The absence of vacancy pairs formed during this process suggests that the probable mechanism is the diffusion of interstitial magnesium ions to the vacancies with an activation energy of 2.7 eV. The efficiency of vacancy production is an order of magnitude less than that predicted for primary displacements, indicating the importance of the athermal recombination between vacancies and those interstitials formed within a critical volume around the vacancy. Comparison of the rate of initial anion defect production as a function of particle size of the powder indicates that the surface can compete with the vacancy as a trap for oxygen ions displaced from vacancies up to several tens of angstroms from the surface, thus reducing the vacancy–interstitial recombination process. The initial rates of cation and anion vacancy production are found to be in the ratio of between 3 and 4, in reasonable agreement with the ratio of the displacement cross sections of the two ions. (auth)

3088 APPLICATION OF THE DETONATION PHENOMENON IN THE DEPOSITION OF COATINGS: A REVIEW. Zverev, A. I.; Miroshnichenko, I. Yu. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 891-899 (Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 36-47(Nov 1972).

The disadvantages of the gas-flame and plasma techniques for deposition of materials are described, and principles and practical considerations in deposition by detonation in gases are discussed. Properties of coatings deposited by the latter process are superior (higher density, adhesion, resistance, etc.) to those deposited by the two former processes. Some of the materials which may be deposited by detonation are: WC–Co, Mo–Co, WC–Co–Ni, B_4C + metal, TaC–Co, $MoSi_2$–Co–Cr, Cr–Mo–TaO, CrB–TiB–Ni, etc. (8 tables, 7 figures, 34 references) (DLC)

3089 PLUTONIUM FUEL TECHNOLOGY. PART I. Plutonium Fuel Fabrication. Brite, D. W. (Battelle-Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 87-96(May 1973).

The design of most new plutonium facilities today anticipates a reduction in the maximum permissible personnel radiation exposure from the present 5 to 1 Rem/yr. Plutonium–uranium mixed-oxide fuels for thermal reactors are most frequently prepared from mechanically blended PuO_2 and UO_2 powders. Fuel pellets, fabricated by dry powder preparations, cold pressing, sintering, and grinding to size, are encapsulated in Zircaloy tubes, which are then assembled into bundles as required for each reactor. Alternate mixed-oxide fuel fabrication techniques include preparation of coprecipitated UO_2–PuO_2 powders, binder addition by a wet process, hot pressing, and the use of packed-particle rather than pelletized fuels. Packed-particle fuel materials that have been utilized were prepared by a high energy pneumatic impaction process, a sol–gel process, or by cold pressing and sintering. Such fuel materials are packed in rods by either a vibratory compaction or a swaging process. A quality assurance program is required which covers all planned actions necessary to provide the degree of confidence needed to ensure that the fuels meet or exceed the requirements of design specifications. (auth)

3090 PLUTONIUM FUEL TECHNOLOGY. Part III. Nuclear Criticality Safety Considerations in LWR $(Pu,U)O_2$ Fuel Fabrication. Brown, C. L.; Davenport, L. C.; Oden, D. P. (Battelle-Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 109-114(May 1973).

The nuclear criticality safety aspects of light water reactor $(Pu,U)O_2$ fuel fabrication are reviewed. It is concluded that criticality safety limitations present a major design challenge in those parts of the plant where plutonium and plutonium–uranium solutions are processed. In particular, the requirement of large vessel volume to achieve homogeneous plutonium-uranium blending is complicated by the restrictive criticality safety limits necessary on vessel dimensions. Special vessel design, such as annular geometry, and fixed nuclear poisons are possible innovations to overcome this problem. Once the PuO_2 and UO_2 are mixed and in dry powder form, plant throughput should proceed at a reasonable rate and criticality safety should not limit operations. In dry operations, radiation protection limitations are likely to be more restrictive than criticality safety limitations. The fact that plutonium recycle fuel is to be fabricated in sealed glove boxes makes it more feasible to base criticality safety on limits for unmoderated fuel, in certain parts of the plant, than is now possible in UO_2 fuel fabrication plants. The basic critical masses and dimensions applicable to the fabrication of plutonium recycle fuel are expected to be only slightly more restrictive than those for light water reactor UO_2 fuel. (auth)

3091 GRAIN GROWTH DURING THE SINTERING OF Nb_2O_5. Janackovic, T.; Petrovic, V.; Uskokovic, D.; Ristic, M. M. (Univ., Belgrade). Metallography; 6: No. 2, 171-175(Apr 1973).

A study was made of grain growth in the densification during sintering of α-Nb_2O_5 at 1250 to 1450°C. Electron microscopic observations are given. Grain growth at sintering temperatures of 1250, 1300, and 1350°C followed the law $D \sim t^4$, and at 1400 and 1450°C followed the law $D \sim t^4$. The density increase is proportional to grain growth up to 93% theoretical density (5 mμ); above 93%, density increases more and more slowly, approaching an asymptotic value. (DLC)

3092 UO_2–PuO_2: A DEMONSTRATED FUEL FOR PLUTONIUM UTILIZATION IN THERMAL REACTORS. Freshley, M. D. (Battelle-Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 141-170(May 1973).

Irradiation performance data indicate that the behavior of Zircaloy-clad thermal reactor mixed-oxide fuels is entirely satisfactory. There do not appear to be any inherent performance limitations created by the addition of small amounts of PuO_2 to UO_2. The wide range of test conditions include peak linear heat ratings sufficient to cause fuel melting and peak burnups to over 50,000 MWd/Mtm. Because small PuO_2 additions to UO_2 have an insignificant effect on those fuel properties which could affect irradiation behavior, thermal reactor mixed-oxide fuel performs similarly and equally as well as UO_2-only fuel. The evidence indicates that the PuO_2-rich regions that persist in nonrestructured mechanically mixed, mixed-oxide fuel have an insignificant effect on performance. The extent of plutonium migration which can occur during irradiation also has an insignificant effect on mixed-oxide fuel behavior. Satisfactory defect behavior of Zircaloy-clad UO_2–PuO_2 fuel under normal operating conditions is indicated. Transient behavior can be affected by the presence of abnormally large PuO_2 particles in mixed-oxide fuel; however, the effect appears to be of little practical significance. PuO_2 additions to UO_2 do introduce special considerations related to fuel design and fabrication. However, the successful development of a sound base technology assures the timely utilization of plutonium in water-cooled power reactors on a reload basis beginning in the mid-1970s. (auth)

3093 SOLID ELECTROLYTES: NEW APPLICATIONS FOR ZrO_2. Sproule, R. T. (Corhart Refractories Co., Solon, OH). Microtecnic (Lausanne); 27: No. 2, 95-96(Mar 1973).

The refractory properties of zirconium oxide (melting point 2650°) have led to many well-known uses in the ceramics, metals, chemicals, electronics, and aerospace industries. Only recently, however, have the unusual electrical properties of zirconia been put to use, resulting in completely new approaches to oxygen measurement, hydrogen production, and electrical power generation. (auth)

3094 INDEX OF RADIOGRAMS OF POWDERS OF URANATE HYDRATES. Sobry, R. (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 41: No. 9-10, 542-552(1972). (In French).

The x-ray powder patterns of six synthetic compounds of general formula $mXO \cdot 2UO_3 \cdot (4-2m)\ H_2O$ (X = Ca, Se, Pb, Ba and $O \leq m < 2$) have been indexed. The least-squares indexing method uses the pseudohexagonal character of the compounds. The agreement between the experimental and calculated patterns is better than those determined previously so that the axes are more accurately known. (auth)

3095 STRUCTURE OF INDIUM OXIDE–TIN OXIDE TRANSPARENT CONDUCTING FILMS BY ELECTRON DIFFRACTION AND ELECTRON SPECTROSCOPY. Bosnell, J. R. (Royal Radar Establishment, Great Malvern, Engl.); Waghorne, R. Thin Solid Films; 15: No. 2, 141-148(Feb 1973).

Thin films of indium oxide–tin oxide mixtures produced by rf sputtering have been investigated by transmission electron diffraction and by electron spectroscopy techniques. Results using both methods support the view that, whereas the indium environment is substantially the same as in the starting material, namely In_2O_3, the environment of the tin is changed towards lower binding energies than the SnO_2 starting material. This is not the case when tin oxide alone is deposited in the same sputtering plant. Annealing at temperatures up to 450°C in both air and forming gas, although altering the resistivity appreciably, did not alter this structure dramatically. There was only an obvious sharpening of the electron-diffraction rings. (auth)

3096 PHASES OF TERNARY SYSTEM VANADIUM–NITROGEN–OXYGEN. Brauer, G.; Reuther, H. (Univ., Freiburg i. B.). Z. Anorg. Allg. Chem.; 395: No. 2–3, 151-158(Jan 1973). (In German).

The phase relationship in the ternary system V–N–O was investigated in the region between "VN", "VO", and V_2O_3 by pre-

parative methods, x-ray phase analysis, and measurements of dissociation pressure. A phase diagram was constructed; "VN" and "VO" form mixed crystals with a miscibility gap between the two phases. (auth)

3097 CONTRIBUTIONS TO THE STUDY OF INORGANIC NONSTOICHIOMETRIC COMPOUNDS. 4. Investigation of Phases Between Nb_2O_5 and Nb_3O_7F. Gruehn, R. (Justus-Liebig Univ., Giessen, Ger.). Z. Anorg. Allg. Chem.; 395: No. 2–3, 181-190 (Jan 1973). (In German).

The system $NbO_{2.5}$–NbO_2F was investigated at 1270 ± 20°C in the region of composition from $NbO_{2.5}$ to Nb_3O_7F. The experiments were carried out in sealed platinum tubes. The strain on the platinum wall caused by the inner pressure was reduced by inserting the platinum vessels into quartz tubes which were then sealed at atmospheric pressure. Ranges of homogeneity were found for the compounds H–Nb_2O_5, $Nb_{31}O_{77}F$, and $Nb_{34}O_{84}F_2$. The narrow phases $Nb(O, F)_{2.510}$ and $Nb(O, F)_{2.523}$ probably have hybrid structures, which can be looked upon as a combination of the building elements of their neighbor phases H–Nb_2O_5 and $Nb_{31}O_{77}F$, and $Nb_{31}O_{77}F$ and $Nb_{34}O_{84}F_2$, respectively. (auth)

3098 INTERACTION OF HYDROGEN AND NITROGEN ATOMS ON THE SURFACES OF TRANSITION METALS' NITRIDES. Lavrenko, V. O.; Chekhovs'kii, A. O.; Tikush, V. L.; Kulik, O. P. (Inst. of Problems in Materials Science, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 2, 168-171(Feb 1973). (In Ukrainian).

Hydrogen and nitrogen atom recombination coefficients on the surfaces of nitrides of transition metals of the IV–VI groups were determined at room temperature (by the mobile overlapping sample method) and at high temperatures (by the sound calorimetric method). In the dependences of recombination coefficients, the specificity of energetics of adsorption processes are manifested on the surfaces of the nitrides. (auth)

3099 ADVANCED NUCLEAR FUELS. Lovell, G. H. B. Nucl. Active; 31-35(Jan 1973).

Properties and development of nuclear fuels are discussed. Information is included on high-temperature fuels and fast-breeder fuels. Thermal and physical properties of U, UO_2, UC, US, and UP are listed and discussed. (JRD)

3100 THERMOPHYSICAL PROPERTIES OF HIGH-TEMPERATURE ELECTRICAL INSULATING MATERIALS BASED ON NON-METALLIC HIGH-MELTING COMPOUNDS. Samsonov, G. V.; Andreeva, T. V.; Dubovik, T. V. (Inst. of Problems in Materials Science, Kiev). High Temp.-High Pressures; 4: No. 5, 537-539(1972). (In German).

Concepts relating to stable electron configurations were used to develop new high-temperature insulating materials by powder metallurgy methods. Thermophysical properties were measured for aluminum nitride, AlN–BN–B_4C, Al–BN–B_4C, boron nitride, boron carbonitride, and the latter alloyed with magnesium. Their thermal conductivity and thermal expansion coefficients were measured in the range 20 to 2000°K. The thermal conductivity of aluminum nitride, AlN–BN–B_4C, boron nitride, and boron carbonitride decreases, and that of the other two materials increases, with increasing temperature. The coefficient of thermal expansion of the materials is low which makes them withstand thermal shock. Their high thermal stability, mechanical strength, electrical insulation properties, and resistance to corrosion, in particular by fused media and their vapours, make them very suitable for high-temperature technology. (auth)

3101 ELECTRICAL RESISTIVITY OF CASTABLE ZIRCONIAS. McMahon, B. J.; Rothwell, E. (Univ. of Sheffield, Eng.). High Temp.–High Pressures; 4: No. 5, 513-521(1972).

A four-probe ac method was used to measure the electrical resistivity of a commercially available castable zirconia over the temperature range 900–1700°K. This castable, which is partially stabilized by the addition of 6 mol % calcia, has better thermal shock resistance and a higher melting point than fully stabilized zirconia. For applications where lower electrical resistivity is required, a higher degree of stabilization is necessary and simple means of increasing the conductivity of the castable without adversely affecting its setting properties were adopted. Measurements on modified castables containing 9, 12, and 15 mol % calcia show a significant reduction of electrical resistivity compared with the initial material; even lower resistivities were obtained using yttria-stabilized castables. The significance of these observations is discussed with reference to the suitability of such castables for applications where optimum electrical properties are important, particularly in the fabrication of high-temperature oxide resistor furnaces. (auth)

3102 HIGH-TEMPERATURE SPECIFIC HEAT OF UO_{2+x}. Hoch, M. (Univ. of Cincinnati). High Temp.–High Pressures; 4: No. 5, 493-495(1972).

High-temperature specific heat data for UO_{2+x} are interpreted using a model developed earlier. Between room temperature and the melting point, for $0 < x < 0.1$, they can be represented by the equation $C_p = (3 + x)\,3RF\,(\theta_D/T) + (2.85 \pm 0.08) + (19.3 \pm 1.8) \times 10^{-9}T^3$ (J $mol^{-1}K^{-1}$). The first term on the right hand side is the Debye approximation for the harmonic contribution; the two terms in the square brackets are anharmonicity terms, the first being the contribution of the uranium and the "normal" oxygen atoms, and the second of the excess "interstitial" oxygen atoms. The large difference between these two terms is discussed. (auth)

3103 COOPERATIVE THERMAL-EXPANSION MEASUREMENTS BETWEEN 1000 AND 2600°C. Fitzer, E.; Weisenburger, S. (Univ., Karlsruhe, Ger.). High Temp.–High Pressures; 4: No. 5, 559-571(1972).

As part of a major AGARD project concerning the measurement of the thermophysical properties of solid materials at high temperatures, cooperative thermal-expansion measurements between 1000 and 2600°C were performed on parallel samples with the same history by 14 laboratories, employing different measurement techniques such as push rods, twin microscopes, interferometry, and x-ray methods. Pure platinum, sintered alumina, sintered tungsten, and two types of polycrystalline graphites were used as sample materials. Results were analyzed for possible error sources, and conclusions were drawn with respect to the accuracy of the experimental data obtained by the different methods and to the suitability of various materials for cooperative measurements. Platinum and alumina were found to be useful reference materials for the intermediate temperature range up to 1600°C. In the high-temperature range, tungsten and fine-grained polycrystalline graphites can serve as reference materials. Twin microscope and push-rod techniques produce approximately the same data scatter in the temperature range 1000 to 1600°C. Above 2000°C the twin-microscope technique seems to be more accurate. (auth)

3104 COMPRESSIVE CREEP AND HOT HARDNESS OF U–Pu CARBIDES. Tokar, M. (Los Alamos Scientific Lab., NM). J. Amer. Ceram. Soc.; 56: No. 4, 173-177(Apr 1973).

The compressive creep of carbides having the composition $U_{0.79}Pu_{0.21}C_{1.02}$ and a sintered density of 11.8 g/cm^3 was studied at 1300°, 1400°, and 1500°C and stresses of 2000, 4000, and 6000 psi. The equation that best fitted the data was $\dot{\epsilon} = 7.96 \times 10^4\ \sigma^{2.44}$ exp (–126.4 kcal/mol/RT). The dominant creep mechanism was probably grain-boundary sliding. The hardness of monocarbides with various U/Pu ratios was measured from room temperature to 1200°C. Probable mechanisms of deformation are discussed. (auth)

3105 THERMAL EXPANSION IN THE SYSTEM Y_2O_3–HfO_2. Stacy, D. W.; Wilder, D. R. (Ames Lab., Iowa). J. Amer. Ceram. Soc.; 56: No. 4, 244(Apr 1973).

The thermal expansion of Y_2O_3–HfO_2 systems is of importance to potential use of HfO_2 as a nuclear control material. Hafnia exhibits a destructive transformation near 1750°C comparable to that in ZrO_2; Y_2O_3 is effective in stabilizing HfO_2. The Y_2O_3 used was produced as clinker from the calcination of hydrated yttrium oxalate. Yttria specimens were hot-pressed at 1600°C for 15 min at 3300 psi. The HfO_2 was obtained as spectrographic-grade hafnium oxychloride. The mean thermal expansion coefficients from 25 to 2000°C for the Y_2O_3–HfO_2 fluorite phases were calculated and compared with the mean thermal expansion coefficients for Y_2O_3 for the same temperatures. It is shown that a high-temperature ceramic material may be produced by adding from 8 to 50 mol % Y_2O_3 to HfO_2. (JCW)

3106 WORK OF FRACTURE OF BeO. Lynch, J. F. (National Beryllia Corp., Haskell, NJ); Bradt, R. C. J. Amer. Ceram. Soc.; 56: No. 4, 228-229(Apr 1973).

Studies of the fracture behavior of polycrystalline Al_2O_3 and MgO suggest that their fracture energies increase with increasing grain size. The reverse behavior has been reported for UO_2 and Al_2O_3. A study of the fracture energy of a fine-grained BeO specimen suggested that BeO may be tougher than these oxides. The results of work-of-fracture measurements made on 7 commercial beryllias are reported and the effect of grain size on fracture energy is determined. Previous data of Al_2O_3 and MgO are compared with the results obtained for beryllia. For the beryllias, there appears to be no obvious correlation of work-of-fracture with the compositional, processing, density, and strength variables; however, fracture energy does appear to increase slightly with increasing grain size, although there is some scatter as a result of differences in composition, processing, and grain morphology. (JCW)

3107 UNIDIRECTIONAL SOLIDIFICATION OF STABILIZED HfO_2–W. Johnson, T. A.; Benzel, J. F. (Georgia Inst. of Tech., Atlanta, GA). J. Amer. Ceram. Soc.; 56: No. 4, 234(Apr 1973).

The procedure is given for successfully using yttria as a stabilizer for the HfO_2–W system. Yttria does not form compounds with hafnia or tungsten. Hafnia samples stabilized with 10 mol % Y_2O_3 and containing 12.3 wt % W were unidirectionally solidified to produce composites containing large areas of uniformly dispersed W fibers 0.15 μm in diameter. The fiber density in this specimen, $7.2 \times 10^7/cm^2$ (lowering rate 1 cm/h), is the highest fiber density reported to date in any oxide-metal system. Slower growth rates produced samples with fibers of larger diameter and lower densities. When less than the optimum amount of W (12.3 wt %) was added, areas of primary oxide surrounded by eutectic areas containing fibers were solidified. When the W addition was ≳13.7 wt %, dendrites were solidified within the fiber areas. Well-ordered eutectic areas solidified from HfO_2 + 10 mol % Y_2O_3 + 12.3 wt % W contained only 2.5 wt % W in the final eutectic structure. (JCW)

3108 SYNTHESIS, VAPORIZATION, AND CRYSTAL GROWTH OF GADOLINIUM AND HOLMIUM NITRIDES. Kordis, J. (Texas A and M Univ., College Station); Gingerich, K. A.; Seyse, R. J.; Kaldis, E.; Bischof, R. J. Cryst. Growth; 17: 51-60(Dec 1972).

From 2nd international conference on vapour growth and epitaxy; Jerusalem, Israel (21 May 1972).

See CONF-720584–.

The vaporization of gadolinium and holmium mononitrides was studied and the partial pressures of the vapor species were determined by Knudsen–effusion mass spectrometry. No evidence of gaseous GdN or HoN was found. The nitrides vaporize congruently by dissociation into metal vapor and molecular nitrogen. The synthesis by the amalgam method of gadolinium and holmium nitrides is described and the difficulties in obtaining pure and stoichiometric samples are critically discussed. Single crystals of these compounds were grown by sublimation in sealed molybdenum crucibles. The growth rates were found to be of the order of 10^{-7} (HoN) to 10^{-8} (GdN) cm/s. To find out the reason for these low values an estimation of the average evaporation–condensation coefficient of these compounds was made. This was accomplished by comparing the maximum flux calculated by the Langmuir–Knudsen equation from the measured vapor pressures and the crystal growth temperatures, with the flux corresponding to the experimentally measured growth rate. Values of the order of 10^{-3} were found for the average evaporation–condensation coefficient of both nitrides, indicating that the surface reaction is the rate determining process during crystal growth. From the mass spectrometric measurements, second-law enthalpy values of $\Delta H^\circ_{298} = 174 \pm 6$ kcal and $\Delta H^\circ_{298} = 157 \pm 6$ kcal were found for the reactions GdN (s) = Gd (g) + ½N_2 (g) and HoN (s) = Ho (g) + ½N_2 (g) respectively. When these enthalpies are combined with the known literature values for the enthalpy of vaporization of the metals, the standard enthalpies of formation of GdN (s), $\Delta H^\circ_{f,298} = -79 \pm 6$ kcal/mole, and of HoN (s) $\Delta H^\circ_{f,298} = -85 \pm 6$ kcal/mole are obtained. (auth)

3109 CRYSTAL GROWTH OF VANADIUM OXIDES BY CHEMICAL TRANSPORT. Nagasawa, K. (Mitsubishi Electric Corp., Amagasaki, Japan); Bando, Y.; Takada, T. J. Cryst. Growth; 17: 143-148(Dec 1972).

From 2nd international conference on vapour growth and epitaxy; Jerusalem, Israel (21 May 1972).

See CONF-720584–.

Single crystals of VO_2, V_2O_3, and the intermediate vanadium oxides between VO_2 and V_2O_3 with the general formula V_nO_{2n-1} (n = 3, 4, 5, 6, 7, 8) were grown by chemical transport using $TeCl_4$ as a transport agent. The crystallography of V_nO_{2n-1} and the electrical properties of the grown crystals are studied. Some related topics are reviewed. (auth)

3110 THIN FILMS OF METAL OXIDES ON SILICON BY CHEMICAL VAPOR DEPOSITION WITH ORGANOMETALLIC COMPOUNDS. I. Balog, M.; Schieber, M.; Patai, S.; Michman, M. (Hebrew Univ., Jerusalem). J. Cryst. Growth; 17: 298-301(Dec 1972).

From 2nd international conference on vapour growth and epitaxy; Jerusalem, Israel (21 May 1972).

See CONF-720584–.

Thin films of TiO_2, ZrO_2, and HfO_2 were deposited on single crystals of (111) silicon, by chemical vapor deposition (CVD) of the respective organometallic compounds. The thin films of TiO_2 have the anatase structure while ZrO_2 and HfO_2 are monoclinic. All films are easily etched by 5% HF solution, while films of TiO_2 are also etched by 70% H_2SO_4. The indices of refraction of the thin films are 2.05 to 2.26 for TiO_2, 1.94 for ZrO_2, and 2.02 for HfO_2. All the oxide films show good MOS C–V characteristics, the flatband voltages having values near zero. The bias-temperature (B–T) tests on C–V curves in the case of HfO_2 show high stability. (auth)

3111 TEMPERATURE DEPENDENCE OF ELECTRIC CONDUCTIVITY OF NONSTABILIZED ZIRCONIUM DIOXIDE. Kutzendoerfer, J.; Sramek, J. (Inst. of Chemical Tech., Prague). Silikaty; 16: No. 4, 311-317(1972). (In Czech).

The measurements were carried out on two samples of nonstabilized ZrO_2 of different porosities, fired at 1700°C, by the two-point method using alternating current and an impedance bridge; a delay of 10 minutes was provided after the temperature conditions at the sample had become equalized. A change in electric conductivity (up to hundred-fold) takes place within the region of modification transformation, i.e., at 1180°C during temperature increase and at 980°C during temperature decrease. Within the stability region of the monoclinic modification the values measured on both samples were relatively close to the conductivity activation energy of 31.4 and 26.6 kcal/mol respectively, independently of whether the measurement was carried out during temperature increase or decrease. Considerably different conductivity values were established in the determination of temperature dependence within the region of tetragonal modification, where the denser sample exhibited a higher conductivity. The values measured during temperature increase were always higher, as well as the activation energy values (31.0 kcal/mol and 18.5 kcal/mol for the higher- and the lower-density samples respectively) than those obtained in the course of cooling down. The conductivity activation energies for cooling down were the same for both samples, namely 12.3 kcal/mol. The resistance was shown to decrease during isothermic delay. This implies that in measurements within the high temperature modification region the conductivity depends on thermal history of the sample. (auth)

3112 STUDY OF THE Nb–H DIAGRAM. Pick, M. A. Ber. Bunsenges. Phys. Chem.; 76: No. 8, 757(1972).

A bcc phase is reported within the orthorhombic β-phase at temperatures below 200°K in a narrow concentration range around $NbH_{0.9}$. (Metals Abstr.)

3113 STRUCTURAL TRANSITIONS AT LOW TEMPERATURES IN VANADIUM HYDRIDES AND DEUTERIDES. Westlake, D. G.; Mueller, M. H. Ber. Bunsenges. Phys. Chem.; 76: No. 8, 757(1972).

At sub-ambient temperatures, V_2D and V_8D_5 exhibit two transitions that involve ordering of the H-like species and adjustments in the interatomic distances of the metal lattices. In the temperature range 220 to 300°K, V_3D_5 has a negative thermal expansion coefficient. (Metals Abstr.)

3114 EFFECT OF MINOR CONSTITUENTS ON THE PROPERTIES OF VANADIUM AND NIOBIUM HYDRIDES. Reilly, J. J.; Wiswall, R. H. Jr. Ber. Bunsenges. Phys. Chem.; 76: No. 8, 756(1972).

Small amounts of impurity have a large effect on the stability of $VH_{\sim 2}$. The ratios of the dissociation pressure of V hydride with and without various concentrations of impurities are tabulated. (Metals Abstr.)

3115 EFFECT OF OXIDE FLUX UPON THE ELECTRIC CHARACTERISTICS OF THE FORSTERITE BODY. Park, S. J.; Yo-up Hoeji; 8: No. 2, 81-97(1971).

The effect of oxides, such as Al_2O_3, TiO_2, ZrO_2, CdO, SrO, and PbO on sintering and electrical properties of forsterites was studied by analyzing data on water absorption, thermal expansion, insulation resistance, dielectric loss factor, x-ray diffraction patterns, and electron micrograph results. The forsterite bodies were prepared by adding 2 to 10wt.% of each oxide, and firing to 1370, 1410, and 1450°C for 2 hrs. It was found that sintering temperatures were lowered with the addition of oxides, and in the same time with the specimens containing 10% Al_2O_3, spinel was detected, and with the samples containing 10% SrO, inclusion of strontium silicate in the body was confirmed. On the other hand, all samples containing ZrO_2 fired at 1450°C, some unreacted ZrO_2 was detected through x-ray analysis. For other oxides, the more the oxides were added, the lower the sintering temperature was, and the large amount of resulted glassy substance lowered specific resistivities and raised dielectric loss factors. Among the oxides tested, PbO was found to be the most favorable flux; 5 to 7×10^{15} ohm-cm being specific resistivity, 6.4 to 7.7, 4 to 5×10^{-4} and 0.0025 to 0.0041 being the values for dielectric constant, dielectric loss tangent and dielectric loss factor (for 40 MHz), respectively, obtained at the room temperature. (auth)

3116 PHASE EQUILIBRIA IN ALLOYS V–N–Sc (Y, Ce, Pr). Barabash, O. M.; Shurin, A. K.; Yakovchuk, Yu. E. Izv. Akad. Nauk SSSR, Metal.; No. 1, 212-215(1973). (In Russian).

Isothermal diagrams were constructed for the systems V–N–RE, where RE = Sc, Y, Ce, Pr, in the region of V–VN–RE nitride–RE. Cross sections of the ternary diagram were quasi-binary and possessed peritectic character. Data were obtained on the mutual

solubility of V and rare-earth nitrides at temperatures below 1800°C. The rare-earth metals lowered the solubility of N in V to the extent that this behavior might be the basis for V purification. Ternary compounds were not formed in the systems investigated. Refractory nitrides of the rare-earth metals may be used for toughening V, particularly if properly aged. (tr-auth)

3117 CERAMIC MATERIALS FOR HIGH-TEMPERATURE-REACTORS. Buresch, F. E. (Univ., Stuttgart). Haus der Technik, Essen, Vertragsveroeff.; No. 273, 16-31(1971). (In German).

Ceramic materials such as graphite, Al_2O_3, BeO, and MgO have an advantageous moderating ratio. They are damaged in reactors by nuclear reaction products. The combined action of stresses caused thermically and by irradiation and of elastic internal strains as well as of thermal stresses from stationary and mutual temperature gradients produces demolitions, when the breaking point is exceeded. Thermic radiation caused and elastic internal stresses are inherent properties of materials. By a polygonal fine-grained structure they can be diminished. Thermal stresses are determined by the thermal expansion, the elasticity modulus and the heat conductivity as well as by the pattern and size of the construction part. Thermal stresses are decreased by a high heat conductivity, that is also by a small porosity. Internal and thermal stresses can be reduced by short ruptures. By a coarse granulation structure the stress intensity ratio is increased. Ceramic materials for reactors must show the nuclear properties favorable for the concerned reactor concept. The best mechanical properties are a problem of extreme value which until today has been solved satisfactorily only for reflector graphite. (GF)

3118 TRENIYE I ADGEZIONNOYE VZAIMODEYSTVIYE TUGOPLAVKIKH MATERIALOV PRI VYSOKIKH TEMPERATURAKH. (Friction and Adhesive Interaction of Refractory Materials at High Temperature). Semenov, A. P. Moscow; Izdatel'stvo Nauka (1972). 160p.

The monograph deals with methods and results of studies on the function and adhesive interaction of combinations of both similar and dissimilar refractory materials of various types (metals, carbides, borides, hard alloys, and oxides) at high temperatures (up to 2000°C in vacuum and gaseous media (argon, helium, nitrogen). Approximate regularities for selecting materials to fit couplings for service under friction at high temperature are formulated. The publication is intended for a wide circle of researchers and scientists doing practical work in metallurgy, designers, machine builders, and technologists engaged in studies, planning, design, manufacture, and treatment of various parts from refractory materials. (JPRS)

3119 PARAMAGNETIC RADIATIONAL DEFECT IN PHOSPHATE GLASSES. Starodubtsev, V. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 130-130 (1973). (In Russian).

An analysis of the g-tensor values of PO_4^{2-} radicals showed that an electron situated on a molecular orbital did not hold contributions of the orbitals of the P atom. Irradiated (source unspecified) phosphate glasses with a radiational capture center were studied, and the splitting of molecular orbitals during a change in the electron configuration symmetry of the PO_4^{2-} complex from T_d to C_{3V} is discussed. (KSW)

3120 FABRICATION OF TRANSPARENT ThO_2-DOPED Y_2O_3. Greskovich, C.; Woods, K. N. (General Electric Co., Schenectady, NY). Amer. Ceram. Soc. Bull.; 52: No. 5, 473-478(May 1973).

The sulfate and oxalate processes were developed to produce powders with a composition of 89 mol % Y_2O_3, 10% ThO_2 and 1% Nd_2O_3 and with physical and chemical properties that were favorable for a sintering approach. By ball-milling the calcined oxalate powder, sintered material could be produced with residual porosities as low as $\approx 2.5 \times 10^{-1}$; the majority of pores were between 0.5 and 5 μm, regardless of changes in ceramic processing procedures. Residual small pores are caused primarily by rapid grain growth. Large pores are formed most likely by impurity particles introduced in the green compact, and from incomplete decomposition of the oxalate powder. Orange peel, a point-to-point variation in refractive index, is probably related to chemical inhomogeneities that arise during powder preparation. (auth)

3121 MOLYBDENUM CARBIDE BY ELECTROLYSIS OF SODIUM MOLYBDATE. Suri, A. K.; Mukherjee, T. K.; Gupta, C. K. (Bhabha Atomic Research Center, Bombay). J. Electrochem. Soc.; 120: No. 5, 622-624(May 1973).

Preparation of di-molybdenum carbide from sodium molybdate dissolved in fused bath of sodium carbonate, sodium tetraborate, sodium fluoride, and potassium fluoride was investigated. Under the optimum conditions established, a maximum electrodeposition rate corresponding to 0.5 g/A-hr of the carbide was obtained. In the follow-up investigation the carbide was admixed with monitored amounts of molybdenum dioxide for vacuum thermal sintering treatment to yield molybdenum metal of purity comparable to conventional molybdenum extraction process. (auth)

3122 NEW TYPE OF MICROSTRUCTURE FOR TiC–Mo–Ni–C CERMET. Kudaka, K. (Japan Research Corp., Tokyo). Amer. Ceram. Soc. Bull.; 52: No. 5, 484(May 1973).

To produce a new type of microstructure, titanium–molybdenum double carbide powder is first formed, and then a cermet is produced from the double carbide and binder metal powders. The process is described. Results showed that the new type carbide grains did not have the double structures that had been seen in the conventional type, but were uniform not only in composition, but also in grain size. The new type cermets had hardness of 92.5 HRA and transverse strength of 140 kg/mm^2, compared to 92.0 HRA and 120 kg/mm^2 of conventional cermets. The results of cutting tests showed the cermets with the new type of microstructure had better flank wear (wear on the flank of the tool) than the conventional ones and almost the same crater wear (wear on the contact surface between the chip and the rake face of the tool). (JCW)

Metals and Alloys

3123 (ORNL-TM-4175) DESIGN OF INDUCTION PROBES FOR MEASUREMENT OF LEVEL OF LIQUID METALS. Dodd, C. V.; Cheng, C. C.; Nestor, C. W. Jr.; Hofstra, R. B. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 118p. Dep. NTIS $8.00.

General analyses of eddy-current probes for measuring the level of liquid metals are presented. The case of a coil encircling a level chamber and the case of a coil inside a level chamber have been solved theoretically; computer programs are included for the latter case. As a specific example, a probe enclosed in molybdenum (a good conductor) was designed to measure the level of molten bismuth (a poor conductor). By using a computer analysis, the sensitivity of the probe to level changes is maximized while the sensitivity to undesirable variables, such as temperature changes, is minimized. Experimental measurements demonstrated that the level could be measured to within ±0.080 in. over a level range from 0 to 13 in. within a temperature range of 600 to 650°C. The high degree of success achieved in the probe design and measurements for this unfavorable combination of conductors indicate that highly accurate eddy-current measurements can be made with almost any combination of conductors. (auth)

3124 (RFP-2005) URANIUM–TITANIUM ALLOYS: ANNOTATED BIBLIOGRAPHY. Jackson, R. J. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 6 Apr 1973. Contract AT(29-1)-1106. 22p. Dep. NTIS $3.00.

An annotated bibliography is presented for binary uranium–titanium alloys. The bibliography is complete as of January 1, 1973. Most of the references were obtained from Nuclear Science Abstracts, and to a minor extent from other sources. The accompanying resumes do not necessarily represent an entire summary of the referenced work because emphasis was placed only on that portion dealing with binary alloys of uranium containing titanium. The references are categorized according to subject. Within a given subject, the references are listed chronologically. Progress Reports and Newsletters (Section P) are also included in the Bibliography; however, these references are listed separately, and are categorized according to source and not subject. In all cases, each reference is listed only once. A subject index is provided for overlapping subject matter. An index of organizational symbols and an author index are also provided. (auth)

3125 POWERFUL MAGNETS FROM RARE EARTH–COBALT ALLOYS. Wells, M. G. H.; Ratnam, D. V. Precis. Metal; 30: No. 12, 36-37(Dec 1972).

Extremely powerful permanent magnets can be fabricated from intermetallic compounds containing rare earths and Co. The magnets were prepared by casting, organic bonding, and powder metallurgy techniques and are under study for use in microwave devices, motors, generators, frictionless bearings, and many aerospace applications. (Metals Abstr.)

3126 PLUTONIUM-DOKUMENTATION. Referate-Zeitschrift mit anhang Transplutonium-Elemente. Februar 1973. Band 7, Heft 2. 258 referate (register-Nr. 426-902); 90 referate (register-Nr. 94T-183T). (Plutonium Documentation. Abstract Journal with Appendix on Transplutonium Elements. February 1973. Vol. 7, No. 2. 258 abstracts (register No. 426-902); 90 abstracts (register No. 94T-183T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1973). 144p. (In German and English).

3127 METALLOGRAFIYA TUGOPLAVKIKH, REDKIKH I RADIOAKTIVNYKH METALLOV I SPLAVOV. (Metallography of Refractory, Rare, and Radioactive Metals and Alloys). Mal'tsev, M. V. Moscow; Metallurgiya Nauka (1971). 488p.

The book deals with structures, properties, and the application of refractory, rare, and radioactive metals and their alloys. The structures of most typical alloys are shown in macro- and microphotographs combined into an atlas to serve as a manual for the analysis of different structures of commercial alloys. The book is intended for a wide circle of engineering and technical personnel in the metallurgical industry and scientific research institutes associated with producing and using these metals, and may serve as a textbook for students in metallurgy. (JPRS)

3128 METALLURGIYA I METALLOVEDENIYE CHISTYKH METALLOV. (Metallurgy and Metal Science of Pure Metals). Emel'yanov, V. S.; Evstyukhin, A. I. (eds.). Collection of Scientific Works of Moscow Engineering Physics Institute, No. 9. Moscow; Atomizdat (1971). 176p.

The collection contains original works on the investigation of the structure and physico-mechanical properties of various refractory, rare, and radioactive metals: molybdenum, tungsten, zirconium, vanadium, uranium, and their alloys and compounds. Problems of refining metals are discussed, and a theoretical explanation is given of the process of refining by means of transport reactions. Experimental results of these processes are presented. Particular attention is given to the study of properties of pure metals, their alloys, and compounds. Results are presented of studies of the fine structure of pure metals in polycrystalline and monocrystalline states by means of different methods, the distribution of admixtures in them, and corrosion, sublimation, diffusion characteristics, internal friction, and other properties of refractory metals, alloys, and compounds. The strength and plasticity properties of metals and alloys in connection with their processing and application are discussed. (326 references) (JPRS)

Corrosion and Erosion

Refer also to abstracts 2781 and 3088.

3129 (AECL-4139) THERMODYNAMICS OF METAL-WATER SYSTEMS AT ELEVATED TEMPERATURES. Part 4. The Nickel-Water System. Macdonald, D. D. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Dec 1972. 55p. Dep. NTIS (U. S. Sales Only) $4.75. AECL $1.50.

Free energies of formation for nickel, nickel oxides, and ionic species in solution are calculated at elevated temperatures by integrating free energy functions over the range 25 to 300°C. These data are used to derive potential-pH relationships for the nickel-water system and to calculate solubilities of nickel and nickel oxide (NiO) in aqueous solution as a function of pH and temperature. The potential-pH relationships reveal an expanded region of corrosion in alkaline solution at elevated temperatures due to the increased stability of $HNiO_2^-$. Solubility calculations show that the direction of transport of Ni and NiO across a temperature gradient by differential solubility is dependent on the pH of the system, for example, NiO will be transported from the hotter to the colder regions (250°C < T < 300°C) of a nonisothermal system at $pH_{25} > 10$. At lower pH_{25} values, transport will occur in the reverse direction. (23 references, 10 figures, tables) (auth)

3130 (COO-3166-5) ENVIRONMENT AND FRACTURE. Progress Report. Johnson, H. H. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). 7 Mar 1973. Contract AT(11-1)-3166. 11p. Dep. NTIS $3.00.

Research progress on phenomenology of hydrogen-induced cracking of structural materials and on parameters associated with cracking mechanisms in materials is summarized. Progress is reported on fatigue crack growth in steel, H diffusion in Fe near 300°K, and H diffusion in materials near cracks. (JRD)

3131 (FRNC-TH-279) CONTRIBUTION TO THE STUDY OF Hf OXIDATION. Pieraggi, B. (Toulouse Univ. (France)). 1971. 61p. (In French). Dep. NTIS (U. S. Sales Only) $5.25.

Thesis.

Bibliographic data concerning Hf oxidation are presented. The oxidation kinetics of α-phase Hf in air, the growth kinetics of the oxide, and the dissolution kinetics of oxygen into the metal beneath the oxide were investigated. The diffusion coefficient of oxygen into Hf was determined from microhardness and kinetic measurements. The experimental results concerning the structural and morphological characteristics of the oxide formed (thin continuous films or thick layers) were determined using optical or transmission electron microscopy. The oxidation of Hf-Cu3 (3.30% at. Cu) and Hf-Cu6 (5.65% at. Cu) alloys were also studied. (FR)

3132 (KFK-1718) INVESTIGATIONS OF THE REACTION BEHAVIOR OF VANADIUM-BASE ALLOYS WITH SIMULATED FISSION PRODUCTS IN PRESENCE OF UO_2 AND UC. Hofmann, P.; Goetzmann, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jan 1973. 77p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

The two vanadium-base alloys V-T13-Si1 and V-Zr2-Cr15 were tested in contact with various fission-product elements at temperatures between 600 and 900°C and annealing times of 1,000 hours. The tests were made with pure fission-product elements, groups of such elements, and mixtures of oxide nuclear fuel of various O/M ratios and fission-product elements, as well as similar mixtures with carbide nuclear fuel of different carbon contents. Metallography and electron microprobe analyses were employed in the post-annealing investigation. The results are shown by many micrographs and microprobe pictures. These tests should be regarded in connection with similar tests on steels, which are described in an earlier report. Vanadium alloys are more resistant against fission-product attack than stainless steels. Cesium is dangerous only if the alloy contains chromium. The dissolution of alloy components in tellurium and selenium is quite rapid at 800°C. There is only a slight attack of iodine and bromine at this temperature. Cladding attack of fission products was much less when these elements were mixed with fuel in concentrations corresponding to a burnup of 10 at.%. Blended with UC, the fission product-cladding material interactions even disappeared. Embrittlement of vanadium alloys by oxygen uptake from the fuel seems to be more severe than reactions with fission products. Hardening of the vanadium cladding by carbon was observed only when annealed in contact hyperstoichiometric UC. In some cases, it could be shown that carburization was reduced by the presence of fission product elements. (GF)

3133 (RD/B/N-2521) STUDY OF CORROSION AND DEPOSITION IN LIQUID METALS. Part I. Observations on Wedging Corrosion and Mass Transport in the System Zirconium/Sodium/Stainless Steel at 650°C. Fisher, S. B.; Hooper, A. J. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Dec 1972. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The use of zirconium metal at high temperatures in the purification of sodium has been widely reported. Results of a study are given of the interaction between zirconium metal samples and sodium containing an initially high concentration of dissolved oxygen, in which x-ray diffraction, energy dispersive analytical x-ray (EDAX), and e.p.m.a. were used to examine zirconium samples following sodium exposure. Large Na/Zr/O particle growths were observed and this was ascribed to Na_2ZrO_3 formation and consequent wedging corrosion of the zirconium. This wedging corrosion mechanism may lead to degradation of the zirconium foil, which could cause operational difficulties. The observed mass transfer of constituent elements of stainless steel to the zirconium is also discussed. (auth)

3134 (RD/B/N-2544) STUDIES ON WASTAGE OF MATERIALS IN THE VICINITY OF SODIUM-WATER REACTIONS. Part I. Preliminary Results of the Wastage of Candidate Boiler Tube Material in a Sodium-Water Vapour Flame. Newman, R. N.; Smith, C. A. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Jan 1973. 12p. (CFR-BMP-P-(73) 136). Dep. NTIS (U. S. Sales Only) $3.00.

Samples of candidate boiler materials have been exposed, on a laboratory scale, to laminar diffusion flames of sodium vapor burning in water vapor. Preliminary results are presented on the resistance of 2 ¼Cr-1Mo steel, 9Cr-1Mo steel, 316 stainless steel, Incoloy 800, and nickel, to attack under these conditions. (auth)

3135 (SGAE-2074) CORROSION EXPERIMENT 1.6. Final Report. Schwarz, N.; Kohl, G.; Weiser, O. (Oesterreichische Studiengesellschaft fuer Atomenergie G. M. B. H., Seibersdorf. Institut fuer Reaktortechnik). Dec 1972. 43p. (In German). SGAE-RT-49/72). Dep NTIS (U. S. Sales Only) $4.25.

In previous experiments, various materials had shown marked differences in the corrosion rate. Therefore, samples were prepared from only one type of raw material (Boehler-Turbotherm 1616M) but were treated differently before testing. Some were machined and then passivated; others were machined, heat treated, steeped, and then passivated; still others were grooved lengthwise and welded, machined, and passivated. The experiments were performed at 730°C, for a duration of 1500 hours, and with a sodium velocity of 4m/sec. Results were compiled in ten tables and depicted in ten diagrams. (HBG)

3136 (TIM-663) NIOBIUM-1 ZIRCONIUM ALLOY FORCED-CONVECTION LITHIUM CORROSION LOOP TESTS LCCBK-2A2, -3A3, AND -4A4. Bersin, G. W. (Pratt and Whitney Aircraft,

Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 25 Jul 1961. Contract AT(30-1)-2789. 16p. Dep. NTIS. Declassified 15 May 1970.

Lithium was pumped through three loops constructed of Nb–1Zr alloy to determine the ability of this alloy to resist corrosion and mass transfer by 2400°F lithium. These loops were operated in inert atmosphere chambers containing a purified helium environment to prevent contamination of the Nb alloy. Post-test examination of these loops revealed only slight solution attack on the base metal in the high-temperature zones and no measurable deposition. The LCCBK-2A2 and LCCBK-3A3 loops operated for 153 and 14 hours, respectively, at which time the tests were terminated due to lithium leakage. The LCCBK-4A4 loop operated for 513 hours at which time the test was terminated due to a flow interruption. (auth)

3137 THERMIONIC CONSTANTS AND ELECTRON REFLECTION FOR Ta(100) BY THE SHELTON RETARDING FIELD METHOD. Finn, R. M.; Nicholson, D. J.; Trischka, J. W. (Syracuse Univ., NY). Surface Sci.; 34: No. 3, 522-546(Feb 1973).

The Shelton retarding field method was employed to determine the thermionic constants of the (100) surface of tantalum in the temperature range 1500 to 1730°K: $\phi^* = 4.16 \pm 0.05$ V, $d\phi/dt = 56 \pm 5\ \mu V/°K$, and $A_R = 122 \pm 26\ A/cm^2K^2 \cdot \phi = 4.24 \pm 0.05$ V at 300°K. A refined analysis of the Shelton method shows the importance of four reflection coefficients, because of which A_R cannot be identified unambiguously as the preexponential constant appearing in the Richardson equation. The dependence on incident energy of the electron reflection coefficient of Ta(100) was observed in the range 0 to 100 eV. The positions at 4.5, 8.0, 11.3, and 17.0 eV of relative reflection maxima agree closely with those observed by others for W(100). Advances are described in instrumentation, experimental technique, and acquisition and analysis of data. (auth)

3138 IN SITU CLEANING OF SPECIMENS IN THE FIELD ION MICROSCOPE BY ARGON ION BOMBARDMENT. Cranstoun, G. K. L.; Browning, D. J.; Pyke, D. R. (Oxford Univ.). Surface Sci.; 34: No. 3, 597-612(Feb 1973).

The extensive adoption of argon bombardment cleaning techniques for specimens used in LEED and Auger studies, and the frequent, and often difficult, requirement of preparing field ion emitters, and their supports, free from contamination, led to the investigation of in-situ argon ion bombardment of specimens in the field of ion microscope, both from the point of view of the efficiency of the cleaning process, and the investigation of ensuing surface and lattice damage. Experiments were carried out for tungsten and rhenium, with a view to obtain information on the thermally annealed end forms of such metals. In both cases, very small radius clean thermally annealed specimens could be prepared. 7 figures. (auth)

3139 CHANGE OF THE WORK FUNCTION OF W(100) BY ADSORPTION OF OXYGEN OR CESIUM AND BY THEIR CO-ADSORPTION. Desplat, J. L. (SEEN–CEN de Saclay, Gif-sur-Yvette, France). Surface Sci.; 34: No. 3, 588-596(Feb 1973). (In French).

The work-function determination by the Kelvin method is used to study the adsorption of oxygen, cesium, and co-adsorption of oxygen and cesium on a (100) tungsten surface at room temperature. The work-function change with oxygen exposure is used to estimate the sticking coefficient and the dipole moment of adsorbed oxygen. During cesium deposition on the clean surface, a minimum at 1.58 eV and a plateau at 1.80 eV are obtained. Starting from the minimum obtained with cesium, oxygen adsorption leads to a decrease of the work function down to 1.17 eV, when cesium adsorption on a previously oxygenated surface gives a 1.12-eV minimum and an increase of the plateau up to 2.20 eV. This last variation is shown to be consistent with the observed increase of the dipole moment of cesium adsorbed on a partially oxygenated surface, which accounts also for the lowering of the work function minimum. (auth)

3140 FIELD-EMISSION MICROSCOPE STUDY OF TUNGSTEN COATED WITH A THIN FILM OF SILICA. Bobev, K.; Mireva, Z.; Boyadzhiiska, M. Izv. Inst. Elektron., Bulg. Akad. Nauk.; 6: 35-46(1972). (In Bulgarian).

The behavior of W filaments coated with thin films of SiO_2 was studied as a function of temperature in a field-emission microscope. Nuclei and epitaxial formations developed to different extents on samples held at 700 to 960°K. The activation energy associated with the migration of the SiO_2 on W single crystals varied from 0.4 to 1 eV, depending on the particular faces involved. 22 references. (Metals Abstr.)

3141 WORK FUNCTION AND ELECTRIC-FIELD INTENSITY FOR INDIVIDUAL FACES OF A MICROSCOPIC TANTALUM SINGLE CRYSTAL USING AN ELECTRON-GUN TYPE ASSEMBLY. Dryndarov, N. Izv. Inst. Elektron., Bulg. Akad. Nauk.; 6: 5-11 (1972). (In Bulgarian).

A method of determining the work function and electric field on individual faces of a microscopic Ta single crystal by means of an electron-gun type assembly is described. The theory of the method is presented together with working formulae for the relevant quantities. The projector is furnished with a special probe attached to a universal joint in order to facilitate the measurements. The work functions for the (011), (001), (111), and (211) faces are 4.95, 4.10, 3.95, and 4.30 eV, respectively. (12 references) (Metals Abstr.)

3142 FIELD-EMISSION MICROSCOPE STUDY OF THE WORK FUNCTION OF TUNGSTEN COATED WITH SILICA AND TANTALUM. Bobev, K.; Mireva, Z. Izv. Inst. Elektron., Bulg. Akad. Nauk.; 6: 29-34(1972). (In Bulgarian).

The work functions of W filaments coated with thin films of SiO_2 and further coated with sputtered Ta films after heating to 850°K to promote migration of the surface atoms were studied. Coating of the surface produced considerable changes in structure (several cases of which are illustrated), in the form of the V/A characteristics, and in the work function, typical values of which ranged from 4.3 to 4.6 eV. (Metals Abstr.)

3143 EFFECTS OF SOME ACTIVATORS ON SILICONIZING OF MOLYBDENUM AND NIOBIUM. Sosnovskii, L. A.; Epik, A. P.; Tverdokhleb, V. S. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 10, 854-856(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 98-100(Oct 1972).

Halides, chlorinated hydrocarbons, and benzene were investigated as activating additions for the siliconizing of MCh-1 (molybdenum) and VN-4 (niobium) alloys for 3 h at 1050°C. The thickness of the resulting silicide coatings was measured. K_2SiF_6 is shown to be advantageous over KF and NaF. Siliconizing for 3 h at 1120°C in 95% Si–5% TiH_2 has no effect on the appearance of Mo, Nb, and Ti. (DLC)

3144 GROWTH OF DIELECTRIC ALUMINUM AND TANTALUM OXIDE LAYERS. Effenberger, E. Z. Metallk.; 64: No. 1, 62-64(1973). (In German).

Radioactive labeling methods were used to investigate layer growth on anodically oxidized Al and Ta foils. It was found that growth of the dielectric oxide layer formed by anodization proceeds at the oxide/metal interface. (GF)

3145 METHODOLOGICAL CHARACTERISTICS OF A LABORATORY STUDY OF THE INTERACTION OF STRUCTURAL MATERIALS WITH AQUEOUS COOLANT AT HIGH PARAMETERS. Gradusov, G. N.; Gumileva, M. G. Tr. Mosk. Energ. Inst.; No. 126, 52-58(1972). (In Russian).

The interaction of structural materials with an aqueous coolant and the mechanism of processes occurring on the surface of various alloys in contact with the aqueous medium at high parameters were investigated, and their behavior under actual conditions was predicted. Studies conducted over many years concerning the interaction of aluminum and zirconium alloys with high-parameter aqueous coolants showed that comparable and reproducible results are obtained in installations of different types if the technique given is strictly observed, whereas any deviations from the technique cause a sharp change in the research results. (JPRS)

3146 CORROSION RESISTANCE OF VANADIUM–NIOBIUM ALLOYS IN 3% SODIUM CHLORIDE SOLUTION. Migay, L. L.; Arons, V. I.; Mal'chevskii, E. G.; Vorob'eva, L. P.; Druzhinina, I. P. Zashch. Metal.; 8: No. 5, 558-560(1972). (In Russian).

Corrosion rates are reported for V–Nb alloys in 3% NaCl at 25°C. The alloys contained Nb 0, 10, 20, 33, 45, 60, or 100%. In 1000-h tests in naturally aerated solutions, an increase in Nb content of the alloy (to 20%) increased the corrosion resistance. Alloys containing Nb 33% had a resistance effectively equal to that of Nb. Cold deformation by 85 to 98% had no significant effect on the corrosion rate. The rate was increased on raising the pH to 12 but was unaffected by lowering the pH to 1.1. No tendency to cracking was found after tests lasting 1000-h on U-shaped specimens. Anodic polarization curves showed a limiting coed deformation with alloys containing Nb ≥ 33%. Mechanical properties of the alloys are listed. Nb additions to V have a favorable effect on the strength and corrosion resistance in 3% NaCl. (Metals Abstr.)

3147 EFFECT OF TUNGSTEN, TITANIUM, AND ZIRCONIUM ON THE STRUCTURE, PHASE COMPOSITION, AND INTERGRANULAR CORROSION OF NICKEL–MOLYBDENUM ALLOYS. Pavlov, S. S.; Svistunova, T. V. Tr. Mosk. Inst. Khim. Mashinostr.; No. 38, 26-31(1971). (In Russian).

A study was made of the microstructure, phase composition, and intergranular corrosion of Ni–Mo (26 to 29%) alloys containing

additions of Fe, W, Ti, and Zr in the quenched and aged conditions after heating for 30 min at 1300°C and for 1 h at 700°C. In the quenched state there was no tendency to intergranular corrosion, although this appeared in the 3% Fe alloy after heating to 1250 to 1300°C for 30 min. W 3.5 to 5.3% additions eliminated this effect, whereas Zr 0.012 to 0.120% and Ti 1.1 to 2.6% increased the penetration of this corrosion after heating in the high temperature region; this effect is probably associated with the additional formation of TiC and Zr (C,N). (Metals Abstr.)

3148 INFLUENCE OF TEMPERATURE ON ANODIC OXIDATION OF NIOBIUM IN PHOSPHATE SOLUTIONS. Ammar, I. A.; *Ismail, I. K. (Univ. of Cairo). Metalloberflaeche; 26:* No. 10, 378-381(1972). (In German).

Anodic oxidation of Nb was studied in 0.1M $(NH_4(H_2PO_4)$ in the temperature range 20 to 70°C. The oxide formation rate is related to the ionic current density (i) by a log/log relation at all temperatures. The slope of the relation between unitary formation rate $R_{(i)}$ (or field) and log i is independent of temperatures. Plots of $R_{(i)}/T^{-1}$ at constant i, and log i/T^{-1} at constant field give parallel straight lines. The results are interpreted in terms of the simple kinetics of galvanostatic anodization based on the exponential law of Guentherschulze and Betz. This simple model is satisfactory for a limited range of current density or field. (GF)

3149 ZASHCHITNYYE POKRYTIYA NA METALLAKH. (Protective Coatings on Metals). Samsonov, G. V. (ed.). Kiev; Naukova Dumka (1971). 212p.

The collection discusses problems of the theory and practice of diffusion separation and formation of protective coatings on metals and alloys. Results are presented for technological processes for application of protective coatings. The technological properties of coatings are described and areas of their application are indicated. The book is designed for materials scientists working on the creation of modern materials for various branches of technology. It may also be useful to engineering and technical workers at enterprises in the machine building, metallurgical, chemical and other branches of industry. (JPRS)

3150 ANODE DISSOLUTION CHARACTERISTICS OF TITANIUM, NIOBIUM, AND CHROMIUM CARBIDES. Cihal, V. (State Research Inst. of Material Protection, Prague); Desestret, A.; Froment, M.; Wagner, G. H. Collect. Czech. Chem. Commun.; 38: No. 3, 827-832(Mar 1973).

The potentiodynamic measurements have shown considerable differences in electrochemical behavior of titanium, niobium, and chromium carbides. With titanium carbide two regions of dissolution appear on the polarization curve in sulphuric acid solutions, the first one at potentials of −200 to 0 mV (s.h.e.) and the second one at oxidation potentials near 1000 mV (s.h.e.). In order to initiate anode dissolution of niobium carbide both in the region of −200 to 0 mV and also at 700 mV (s.h.e.), concentrated solution of sulphuric acid is needed. For chromium carbide, no enhancement of current density in the low-potential region has been observed; at the end of the passivity region, the rate of its dissolution (current densities are considerably lower than for titanium carbide) rises particularly in the transpassivity region. In the solution of concentrated nitric acid similar anodic processes as in sulphuric acid solutions have been observed. (auth)

3151 EFFECTS OF MOLYBDENUM ON THE PITTING POTENTIALS OF FERRITIC STAINLESS STEELS AT VARIOUS TEMPERATURES. Bond, A. P. (Climax Molybdenum Co. of Michigan, Ann Arbor). J. Electrochem. Soc.; 120: No. 5, 603-606(May 1973).

Pitting potential measurements were performed by potentiodynamic scanning at 200 mV/hr in 1M NaCl and 1M NaBr, each saturated with nitrogen. Over the entire temperature range studied, 1 to 70°C, molybdenum additions up to the limit of solid solubility caused a continuous increase in the pitting potentials of 18% Cr ferritic stainless steels. Exposure tests were also performed in various chloride-containing environments, and it was found that pitting rate decreased as the molybdenum content increased. (auth)

Preparation and Fabrication

Refer also to abstracts 2281 and 3057.

3152 (BDX-613-824(Rev.)) CREATION OF LARGE CASTINGS BY THE INVESTMENT PROCESS. Final Report. Cromwell, W. E. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 21p. Dep. NTIS $4.00.

Results of investigations on investment casting are presented. In the course of work the largest known thin-wall aluminum investment castings have been produced and have passed all testing, including static loads and shock. As a result of the coordinated team effort, the casting design is considered to be a functionally acceptable replacement for the forged, machined, and welded plate assembly. This replacement will yield an estimated cost savings in excess of $100 per unit set. A level of confidence has been established in the potential usage of large investment castings for possible future applications. (auth)

3153 (BDX-613-863) HOLE FINISH CONTROL IN 4330 VANADIUM MODIFIED STEEL. Final Report. Mitchell, D. A. (Bendix Corp., Kansas City, MO). Mar 1973. Contract AT(29-1)-613. 13p. Dep. NTIS $3.00.

Two methods were developed for producing 16 microinch (406.4 nm) AA finish holes with 0.0003 inch (7.62 μm) hole tolerance in parts made of 4330 vanadium modified steel. The methods investigated included reaming, boring, burnishing, ballizing, and jig grinding; ballizing and jig grinding were found superior. Ballizing required more evaluation of its variables than did the others. Jig grinding with a mounted grinding stone produced a better hole size and finish than ballizing but required too much time. Substitution of a carbide rotary burr tool shortened the machine time by half while maintaining the surface finish and hole size within design requirements, but the process was still slower than ballizing. To successfully produce the desired hole size and finish, inspection methods will have to be standardized. (auth)

3154 (BDX-613-868) DEEP-DRAWN STAINLESS STEEL COVERS. Technological Spinoff Report. Mitchell, R. E. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT (29-1)-613. 21p. Dep. NTIS $3.25.

The depth of draw for a rectangular cover fabricated by the hydroform process is directly proportional to the size of the cover's corner radii; for steel alloy, it is normally limited to six times the corner radii. A process combining hydroforming and mechanical deep drawing techniques has been developed which increased the depth of draw to 14 times the corner radii. It was used to fabricate two deep drawn stainless steel rectangular covers, needed for electromechanical assemblies, on a 12-inch-diameter hydroforming machine. Each cover required a different blank size and blank configuration, and different drawing pressures to prevent deformation of its sides, edges, and corners. (auth)

3155 (BDX-613-874) ALUMINUM PLATING OF BERYLLIUM WIRE. Technological Spinoff Report. Clay, F. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 15p. Dep. NTIS $4.00.

Static plating tests were made with short lengths of 0.005-in.-diameter beryllium wire to establish plating conditions. The results were used to design and build a fixture with a continuous plating capacity of about 1000 feet of wire per week. Over 5,000 feet of wire were plated in this fixture. A second-generation, wire plater with a larger capacity was then designed and two were built. The two second-generation platers were used over a seven-month period to plate 500,000 feet of wire. Each plater has a capacity of about 15,000 feet per week based on a 0.001-inch thick aluminum coating. They were operated continuously and required attention for about two hours during the first shift of each day. The experience gained with these fixtures confirms the design feasibility of a new plater with a capacity of 50,000 feet per week. (auth)

3156 (RFP-1985) HEATS OF SOLUTION OF BERYLLIUM IN CHEMICAL MILLING SOLUTIONS. Navratil, J. D.; Oetting, F. L. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 24 Jan 1973. Contract AT(29-1)-1106. 6p. Dep. NTIS.

The enthalpies of solution of beryllium in chemical milling solutions were measured in an LKB reaction calorimeter. The enthalpy of -107.3 ± 1.3 kcal · mol^{-1} for a used chemical milling solution containing ~5 g/l beryllium was measured at 25°C and is compared to an enthalpy of -119.8 ± 6.8 kcal · mol^{-1} for the dissolution of beryllium in fresh milling solution. (auth)

3157 (TIM-781(Suppl. 1)) IN-PILE CAPSULE DESIGN REPORT FOR UN FUEL ELEMENT SPECIMENS (TYPE 18B) OPERATING AT 2200°F AND 0.40 kW/cc (80% Ar−20% He). Butler, E. N.; Thoms, K. R. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 10 Feb 1964. Contract AT(30-1)-2789. 17p. Dep. NTIS.

Declassified 20 Oct 1971.

A capsule designed for use in irradiation of pin-type UN matrix fuel elements is described. The fuel specimens are tungsten-lined Nb−1% Zr alloy clad. The capsule incorporates three concentric cylindrical containers, the outer composed of stainless steel, the intermediate fabricated from Nb, and the inner constructed of Nb−1% Zr alloy. The innermost container accommodates three test specimens immersed in lithium. The annulus between the

innermost and intermediate containers is occupied by a coiled electrical heater, four thermocouples, and two neutron flux monitor wires, all of which are immersed in a sodium-potassium alloy. The annulus between the intermediate and outer containers is filled with argon-helium mixture. (JRD)

3158 (TM-62-5-1) COATED FUEL PARTICLES. Browne, C. C.; Funston, E. S.; Latta, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). May 1962. Contract AT(40-1)-2847. 17p. Dep. NTIS.

Declassified 4 Nov 1971.

Activities in programs to prepare coated fuel particles in the size range 0.5 to 50 microns in diameter are summarized. Information is included on particle preparation, particle coating, and particle evaluation. (JRD)

3159 (TM-65-4-16) EVALUATION OF ULTRA FINE TUNGSTEN POWDER FOR FUELED CORES. Seibert, R. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 12 Apr 1965. Contract AT(40-1)-2847. 3p. Dep. NTIS.

Declassified 4 Nov 1971.

The evaluation was made by comparative testing fine W powder produced by hydrogen flame reduction of WF_6 with commercial powder. No particular advantage was found in the use of ultrafine W powder in the preparation of $W-UO_2$ fueled cores. (JRD)

3160 (Y-DA-5011) APPLICATIONS OF ION PLATING IN METALS FABRICATION. Bell, R. T.; Thompson, J. C. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1973. Contract W-7405-eng-26. 14p. (CONF-730325-1). Dep. NTIS $3.00.

From annual meeting on Society of Vacuum Coaters; Chicago, Illinois, USA (28 Mar 1973).

Ion-plating applications used to solve problems encountered in various areas of metals fabrication are described. A thin, ion-plated coat of copper applied to tungsten carbide provides an example of strike coats that have been applied to permit subsequent electrodeposition of other adherent coatings. Gold ion plated on tungsten is shown to improve the ability to cold weld tungsten rods. Data have been obtained that show the decrease in oxidation rate of uranium and uranium alloys when ion plated with aluminum and exposed to one atmosphere of oxygen. Aluminum is also shown to provide corrosion and handling protection for fast-burst reactor fuel elements fabricated of uranium and uranium alloys. (auth)

3161 POSSIBILITY OF HOT DYNAMIC PRESSING OF ALUMINIUM POWDERS SAP. Bogdanov, A. P.; Roman, O. V.; Furs, V. Ya. (Belorussian State Inst., Minsk). Phys. Sintering; 5: No. 1, 43-48(Jan 1973).

It is shown that high-speed briqueting of Al powders allowed obtaining of dense and homogeneous semi-finished products. In order to obtain briquets free of trapped gas it is necessary to heat previously the starting powder. Degassing of the powder decreases the amount of oxide phase and increases the mechanical properties of the final products. (auth)

3162 GRAIN GROWTH OF CHEMICAL-VAPOUR-DEPOSITED TUNGSTEN-22 WT. % RHENIUM ALLOY. Auck, Y. T.; Byrne, J. G. (Univ. of Utah, Salt Lake City). J. Mater. Sci.; 8: No. 4, 559-564(Apr 1973).

The structures of chemical vapour deposited (CVD) tungsten and a tungsten-22 wt % rhenium alloy in the as-deposited condition were studied by scanning and transmission electron microscopy. Deposition occurs by the advancement of ledges up the {111} surfaces of four-sided pyramids. Grain growth was studied in the alloy at thirteen temperatures between 1400 and 2780°C. For annealing times of less than 1 h, the apparent activation energy was 62 ± 2 kcal mol^{-1}. After several hours at temperatures above 2270°C, the rate of grain growth decreased because of the development of bubbles at grain boundaries. Lamellar composition fluctuations were noted metallographically and by electron probe microanalysis. For CVD tungsten, the widening of columnar grains was studied at ten temperatures between 1290 and 2555°C. The rate of increase of columnar grain width became significant only at temperatures above 1980°C. (auth)

3163 PILOT-PLANT PRODUCTION OF CAPACITOR-GRADE TANTALUM POWDER. Jain, S. C.; Bose, D. K.; Gupta, C. K. (Bhabha Atomic Research Centre, Trombay, India). Trans. Indian Inst. Metals; 24: No. 4, 1-8(Dec 1971).

High-purity tantalum powder, for conversion to capacitors, is produced by sodium reduction of potassium tantalum fluoride. In investigations of this reaction carried out in bomb-type reactors (on a scale of up to 2 kg of K_2TaF_7 batch), it has been observed that there is a limitation to the yield (on account of poor mixing) and also there is no control on the particle size distribution of the metal powder in such a static system. The paper proceeds to describe the detailed design of a liquid-liquid reactor assembly, wherein liquid sodium is fed at a controlled rate to an agitated bath of molten tantalum salt in an inert atmosphere. The potentialities of this alternate design also were examined in detail by studying the process variables such as the amount of sodium fed, the time of heat-soak, the amount of flux addition, and the scale of reduction (up to 8 kg of K_2TaF_7/cycle). With this system it was possible to achieve substantial improvement in the yield of tantalum powder, corresponding to a particle size of 7 to 11 microns as specified for capacitor application. For large-scale production of tantalum powder, it is concluded that the liquid-liquid reduction technique will be superior to the closed-bomb-reduction route. (auth)

3164 MACHINING OF TUNGSTEN POWDER COMPACTS. Kuimov, S. D. Sov. Powder Met. Metal Ceram. (Engl. Transl.), 11: No. 10, 848-850(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 92-94(Oct 1972).

Results are presented of experiments on mechanical treatment of blanks pressed of tungsten powder before sintering in order to save tungsten powder. The powder taken off mechanically is suitable for secondary use in pressing without additional processing. The copying lathe CTC-2 is designed and introduced at some plants for mechanical treatment of pressed parts. Its application increased the coefficient of powder use from 0.2-0.4 to 0.5-0.7 and gave an economic effect of 300,000 rubles a year. (auth)

3165 USE OF POROUS SHIMS IN THE DIFFUSION WELDING OF HARD ALLOYS TO STEELS. Mukha, I. M.; Dovbishchuk, M. N.; Kal'nenko, B. I. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 10, 857-860(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 101-105(Oct 1972).

Thermal stresses generated in VK6 hard alloy (WC-6% Co)/U8 carbon steel (0.8% C) welded joints as a result of the difference in linear expansion between these materials can be appreciably lowered by the use of iron shims of about 12% porosity. Iron shims with a porosity of less than 12% can also be employed for the welding of hard alloys to U8 steel, but the welding operation must be followed by heat treatment. At the VK6 hard alloy/Permalloy welded interface, the Permalloy component exhibits a transition layer consisting of solid solutions and chemical compounds formed from the elements present in the materials being welded. (auth)

3166 HIGH-VACUUM INSTALLATION FOR THE ACTIVE BRAZING OF LARGE-SIZED PARTS. Naidich, Yu. V.; Kondratskii, V. A.; Rozhenko, A. A.; Aleshin, D. V.; Korol, D. I.; Polyakov, A. A.; Yastrebov, V. N. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 939-940(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 99-101(Nov 1972).

A description is given of an installation in which parts up to 1 m in size can be actively brazed in a vacuum of 1 to 3×10^{-5} mm Hg at 1000°C. A 20-kW furnace is enclosed in a vacuum chamber. Operation of the installation during a brazing cycle is described. (DLC)

3167 ELECTRON-BEAM REMELTING OF A NICKEL-NIOBIUM MASTER ALLOY. Tarakanov, L. A.; Lyakishev, N. P. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 75, 158-161 (1970). (In Russian).

Results are presented from an experimental work involving refining of nickel-niobium master alloys using remelting in an electron-beam furnace. It was established that the content of lead, tin, and copper in the nickel-niobium master alloy produced from niobium concentrate after electron-beam remelting is equal to or lower than that in a master alloy produced from niobium pentoxide, a more expensive raw material. (JPRS)

3168 BORONIZING OF COBALT AND SOME COBALT BASE ALLOYS. Zhunkovskii, G. L.; Navrotskii, B. S.; Kolosvetov, Yu. P. (Kiev Engineering Inst.). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 11, 888-890(Nov 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 11, 33-35(Nov 1972).

A study was made of the growth kinetics and phase composition of products of the reaction between the Co constituent of hard alloys and a boronizing medium. Alloys with WC contents of 0, 2, 4, 8, and 20% were used. It was found that pure Co had the highest boronizing rate and that activation with potassium fluoborate increased the thickness of the boride coating. The surface layer consists of Co_2B and CoB phases. The coating and the basis metal have microhardnesses of 1100 ± 80 and 220 ± 40 kg/mm^2, respectively. Treatment at temperatures ≥1100°C leads to the formation of a Co + Co_2B eutectic. The hardness of the coating on the alloys is identical with that on pure Co. (DLC)

3169 NEW METHOD FOR ELECTROPOLISHING NIOBIUM FOR TRANSMISSION ELECTRON MICROSCOPY (TEM). Schober, T.; Sorajic, V. (Kernforschungsanlage, Juelich, Ger.). Metallography; 6: No. 2, 183-184(Apr 1973).

A new electrolyte for electropolishing Nb is reported which is noncorrosive, safe to use, and avoids the disadvantages of other electrolytes (hydrogen uptake, low bath temperatures). The electrolyte composition is 0.05 mole/liter $Mg(ClO_4)_2$ in CH_3OH. Optimum operating conditions are given using a commercial unit with PTFE holder. (DLC)

3170 PLUTONIUM FUEL TECHNOLOGY. Part II. Radiation Exposure from Plutonium in LWR Fuel Manufacture. Smith, R. C.; Faust, L. G.; Brackenbush, L. W. (Battelle-Northwest, Richland, WA). Nucl. Technol.; 18: No. 2, 97-108(May 1973).

Personnel radiation exposure problems in fabricating and handling plutonium fuels are described. The effects of variations in plutonium isotopic composition, due to differences in reactor types and fuel exposure and the resultant combined effects on personnel radiation exposure, are also described. It is concluded that increased shielding will be required for plutonium fuel fabrication facilities when full-scale plutonium recycle is under way, due to the higher radiation levels associated with high exposure plutonium and to more restrictive personnel radiation exposure limits than those currently used. However, it should be possible to handle completed plutonium fuel assemblies containing high exposure plutonium without excessive personnel exposure and with a minimum of special handling procedures. (auth)

3171 PREPARATION PROCEDURE OF CUBIC BORON NITRIDE. Sirota, N. N.; Mazurenko, A. M. (to Inst. Fiziki Tverdogo Tela i Poluprovodnikov). Belgian Patent 782,059. 13 Apr 1972. 12p. (In French).

The preparation procedure of cubic boron nitride from hexagonal boron nitride is carried out by simultaneous pressure and elevated temperature treatments applied for a sufficient time to form the cubic structure. The operation is characterized at a pressure of 50 to 90 kilobars and at a temperature of at least 1800°C and at the maximum of 3000°C. (tr-auth)

3172 IN SITU REFLECTION HIGH-ENERGY ELECTRON-DIFFRACTION STUDY OF THE NUCLEATION AND GROWTH OF TANTALUM FILMS. Axelrod, N.; Marcus, R. B. (Bell Telephone Labs., Murray Hill, NJ). Thin Solid Films; 15: No. 2, S21-S23(Feb 1973).

Experiments to determine the structure of β-tantalum are described. The β-Ta structure was found to nucleate on a bcc-Ta surface which contains oxygen and on a β-Ta surface; the bcc structure nucleates on a clean bcc-W or bcc-Ta surface. Once nucleated, both structures continue to propagate under otherwise identical deposition conditions. It is apparent that under relatively clean deposition conditions the structure of tantalum films is nucleation controlled, and that β-Ta is a metastable allotrope. (auth)

3173 METHOD OF PRODUCING VANADIUM PENTOXIDE. Pakhomov, D. A.; Arkhipov, S. M.; Pruntsev, A. E.; Milskii, S. A.; Pleskachev, A. P. U. S. Patent 3,728,442. 17 Apr 1973. Filed date 7 Jun 1971. 8p.

A method is presented of producing vanadium pentoxide, characterized in that ammonium vanadate is treated with a 2.0 to 2.5 N mineral acid at a H^+/VO_3^- ratio = 1.0 to 1.1 g-equivalent. The resultant vanadium acid precipitate is separated from the mother liquor, washed with water to the pH value of the washings equal to 4 to 5, and calcined at a temperature of 500 to 600°C. The proposed method makes possible the production of a granulated dustless final product of a high degree of purity. (auth)

3174 MODEL FOR SECOND-STAGE LIQUID-PHASE SINTERING WITH A PARTIALLY WETTING LIQUID. Gessinger, G. H. (Brown Boveri Research Centre, Baden, Switzerland); Fischmeister, H. F.; Lukas, H. L. Acta Met.; 21: No. 5, 715-724(May 1973).

A precise model for the second stage of liquid-phase sintering with a wetting liquid phase of varying wettability of the solid has been formulated by numerical methods. The model is based on a more general force equation between the solid particles. For the case of exactly spherical particles, it describes the evolution of neck geometry and the rates of neck growth and linear shrinkage. The wetting angle affects mainly the radius of neck curvature, whereas the amount of liquid phase influences all geometrical parameters with the exception of shrinkage and shrinkage rate. The model is also applicable to case of nickel-activated sintering of tungsten where it is in agreement with reported experimental data. (auth)

3175 THERMODYNAMICS OF CHEMICAL TRANSPORT REACTIONS WITH SPECIAL REFERENCES TO THE TRANSPORT OF TANTALUM BY IODINE. Jeffes, J. H. E.; Marples, T. N. R. (Imperial Coll. of Science and Tech., London). J. Cryst. Growth; 17: 46-52(Dec 1972).

From 2nd international conference on vapour growth and epitaxy; Jerusalem, Israel (21 May 1972).

See CONF-720584--.

An adaptation of the method used by Schaefer et al. for studying chemical transport reactions was devised, whereby the rate of transport can be continuously measured. The transport of tantalum by iodine was studied by this method. Optimum transport was observed when T_2 = 1200°C and T_1 = 580 to 700°C according to the iodine content of the tube. The results are compared with the theoretical model previously developed by Alcock and Jeffes. (auth)

3176 THERMODYNAMIC PROPERTIES OF VANADIUM MONONITRIDE. I. Kozheurov, V. A.; Zhikharev, V. M.; Shishkov, V. I.; Gritsishina, G. V. Izv. Vyssh. Ucheb. Zaved., Chern. Met.; No. 8, 10-13(1972). (In Russian).

An experimental apparatus for studying the thermodynamic properties of non-stoichiometric nitrides of metals is described, together with its application to VN. Results obtained for the enthalpy, entropy, Gibbs free energy, and other properties of VN between 1300 and 1650°C and between 0.5 and 760 torr pressure are presented. Isothermal characteristics relating the dissociation pressure of VN to its composition are also presented. (Metals Abstr.)

3177 ANODIC POLARIZATION OF TUNGSTEN IN NEUTRAL AND ALKALINE SOLUTIONS UNDER CONDITIONS OF ANODE FILM GROWTH. Ammar, I. A.; Salim, R. (Univ. of Cairo). Werkst. Korros.; 23: No. 3, 161-167(1972). (In German).

Anodic polarization of W was studied in neutral (Na_2SO_4, NaCl) and alkaline solutions (ammonium borate, Na_2CO_3, Na_3PO_4, and NaOH) by the galvanostatic method under conditions that led to anode film growth. The rate of oxide growth was calculated as a function of current density, and nature, and concentration of electrolyte. Film growth to potentials above 100 V was achieved in alkaline solutions, provided the solution was dilute and the current density was high. The applicability of the high-field ionic conduction was verified from the dependence of both reciprocal capacity and potential on the logarithm of current density. Data were recorded for the coulometric increase of oxide thickness, the constants of the exponential law, and the electric field. (GF)

3178 REACTION OF OXYGEN-CONTAINING MIXTURES WITH MELTS OF REFRACTORY METALS IN PLASMA-ARC PROCESSES. Kashin, V. I.; Klibanov, E. L.; Tsilosani, A. G.; Semenov, V. G.; Vinogradov, N. I. Izv. Akad. Nauk SSSR, Metal.; No. 1, 3-12(1973). (In Russian).

The transfer of oxygen from the gaseous phase into melts of W and Mo during electric arc heating was studied at oxygen pressures of 0.1 to 0.001 atmospheres. Equilibrium values were determined with respect to the plasma concentration and the oxygen concentration in the metals. The refining capability of the arc melting process was related to the rate constant for the solution of oxygen in the molten metal. (tr-auth)

3179 SLAG VISCOSITY OBTAINED FROM MELTING OF FERROBORON. Zhilo, N. L.; Gruzdev, Yu. A.; Chirkov, N. A.; Khryukin, D. Z. Izv. Akad. Nauk SSSR, Metal.; No. 1, 45-49 (1973). (In Russian).

The fusibility and viscosity (1.0 to 1.5 poise) of synthetic and natural slags of ferroboron, and the composition of specially crystallized (1520 to 1780°C) ferroboron slags were studied. An increase in the CaO content (at the expense of Al_2O_3 or MgO) lowered the fusibility of the slags in connection with a replacement of the calcium hexaaluminate and spinel by calcium dialuminate. Replacement of CaO by MgO caused an increase in temperature of melt crystallization, connected with a precipitation of spinel. Increasing the B_2O_3 content lowered the temperature of crystallization of the slags. An optimum slag contained 20 to 22% CaO, 2 to 3% MgO, and 68 to 70% Al_2O_3 possessed a low viscosity and a sufficiently low temperature of crystallization (1640 to 1660°C). (KSW)

3180 PRESSURE SYNTHESIS OF TITANIUM AND ZIRCONIUM HYDRIDES. Hanslik, T.; Mares, F.; Petrina, A. (Inst. of Inorganic Syntheses, Prague). Collect. Czech. Chem. Commun.; 38: No. 3, 664-666(Mar 1973).

Titanium and zirconium hydrides of the hydrogen content corresponding to stoichiometric composition MH_2 were prepared by combining both metals with hydrogen under pressures of 20 to 100 atm and temperatures of 30 to 500°C. A characteristic rapid exothermic course of the reaction was found, and ignition temperature was established. (auth)

3181 ELECTROLESS DEPOSITION OF NICKEL–BORON ALLOYS: MECHANISM OF PROCESS, STRUCTURE, AND SOME PROPERTIES OF DEPOSITS. Gorbunova, K. M.; Ivanov, M. V.; Moiseev, V. P. (Inst. of Physical Chemistry, Moscow). J. Electrochem. Soc.; 120: No. 5, 613-618(May 1973).

The conditions for electroless nickel–boron plating, the process mechanism, and the structure of the alloys as-plated and after annealing at 150 to 700°C were investigated. A correlation of the mechanical and magnetic properties with the changes of phase structure was established. (auth)

Properties, Structure, and Phase Studies

Refer also to abstracts 3029, 3099, 3103, 3118, 3340, 3991, 4002, and 4166.

3182 (CALT-822-48) STUDIES OF ALLOY STRUCTURES AND PROPERTIES. Annual Summary Report, 1 December 1971–1 December 1972. (California Inst. of Tech., Pasadena. Div. of Engineering). [nd]. Contract AT(04-3)-822. 31p. Dep. NTIS.

Research activities are summarized on properties of Kondo alloys, properties and structure of Fe–Mn–Si alloys, properties of Pd–Ni–P–C alloys, structures of amorphous materials, superconductivity of Cu–Nb alloys, properties of Pd–Mn–P alloys, properties of ferromagnets, properties of Ni–Pt–P alloys, superconducting Cu-base alloys, properties of superconducting transition metals, valence bonds in solids, and structure of amorphous alloys. (JRD)

3183 (CEA-R-4414) STUDIES OF THE FRACTURING OF METALLIC SAMPLES SUBJECTED TO A PLANE SHOCK WAVE. Spalling of Cu and U. David, F.; Vacellier, J.; Prouteau, F.; Legrand, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Mar 1973. 111p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

A plane shock wave is induced in copper and two uranium alloys in such a way that spalling occurs. Results of examination of the recovered samples and of the free surface velocity measurements is the basis for assumption that spallation of a metal can be divided in three stages: creation and slow and rapid propagation of cracks. Cracks appear when the tension exceeds a critical level, an approximate value of which is given by the measurements of the free surface velocity variations. When the kinetic energy acquired by both ends of the cracks is neglected, the conservation of energy controls propagation velocity of the cracks and the critical stress which causes the cracks to propagate. In the numerical simulation of the spall mechanism, the critical propagation stress is assimilated to an average cohesion stress in each plane of the flow. Calculations agree with the experimental results. (auth)

3184 (COO-2103-25) ELECTRONIC ENERGY BAND STRUCTURE OF THE ACTINIDE METALS. Final Report. Freeman, A. J.; Koelling, D. D. (Northwestern Univ., Evanston, Ill. Dept. of Physics). 1973. Contract AT(11-1)-2103. 119p. Dep. NTIS $8.00.

Results are reported of a research program undertaken to determine theoretically the electronic band structure of the actinide metals and their compounds in order to provide a basis for understanding their electric (transport), magnetic, and optical properties. The present understanding of the electronic properties of the actinides as derived from the band theory of solids is reviewed. The relativistic augmented plane wave method is considered: nonrelativistic and relativistic formulations are compared, and limitations and complications for heavy metals are discussed. The question of itinerant f states is considered for Ac, Th, U, Np, and Pu. The question of whether the heavy actinides constitute a second rare earth series is also considered. (4 tables, 33 figures, 104 references) (DLC)

3185 (COO-3166-3) PERMEATION OF HYDROGEN THROUGH ANNEALED AND DEFORMED IRONS. Kumnick, A. J. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Aug 1972. 82p. Dep. NTIS $6.25.

Thesis.

The influence of deformation and annealing on the permeation of hydrogen through iron was studied. An electrochemical technique with a resolution of 10^{-13} moles H/cm^{2}sec was used to monitor the hydrogen flux over 5 to 60°C. Hydrogen entry was effected with either cathodic polarization or hydrogen gas at 1 atm pressure. The activation energy for hydrogen diffusion was found to be 4.2 ± .5 kcal/mole for well-annealed material over the temperature range mentioned above. The disagreement with high-temperature results is accounted for in terms of trapping. The activation energy measured for permeation was 8.9 ± 0.5 kcal/mole. A thickness effect of the effective diffusivity was also accounted for on the basis of a trapping. The effective diffusivity decreases with increasing plastic deformation. However, the effect of plastic deformation anneals out over the temperature range 100 to 400°C. Isochronal annealing studies are reported. The activation energy for the annealing process was determined for isothermal measurements to range from 15 to 48 kcal/mole. The product of the steady state flux and specimen thickness was found to be independent of specimen condition. (auth)

3186 (EUR-4949) MECHANICAL TESTING AND METALLURGICAL EXAMINATIONS OF PRESSURE TUBES MADE FROM Zr–2.5% Nb ALLOY, 92 × 98 mm DIAMETER. Extruded, Quenched, and Cold Reduced. Beghi, G.; Henry, B. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 44p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.25. EUR FB 60,-.

The results of mechanical tests and metallurgical examinations aiming to characterize a batch of 7 Zr–2.5% Nb pressure tubes, 92 × 98 mm dia., extruded, ($\beta+\alpha$) quenched and cold reduced, are reported. The tubes have a high mechanical strength and a good ductility. The mean value of the transverse ultimate strength is 95.4 kg/mm^2 and 64.3 kg/mm^2 at 20 and 300°C respectively. The microstructure is characterized by the prominent longitudinal orientation of the α-primary grains, as a result of the cold tube reducing. The hydrides precipitated by exposure to steam at 480°C are oriented in the longitudinal direction. The texture is characterized by the approximately equivalent percentage of grains having the hexagonal poles in the radial (C) and circumferential (A) directions. The longitudinal orientation (D) does not appear. The strength, strain and thermal dilatation anisotropies are consistent with the observed texture. All the properties are constant on both the front and the base of each tube and for all the tubes, except for the front of one tube and the base of another one, the strength of which were lower than the mean value. This relative weakness appears to be consistent with a more pronounced radial orientation (C) ascertained on the same place of these tubes. (auth)

3187 (EURFNR-1028) IN-PILE STRESS RUPTURE AND CREEP BEHAVIOR OF THE ALLOY INCOLOY 800. Closs, K. D.; Schaefer, L. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). May 1972. 20p. (KFK-1599). Dep. NTIS $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The in-pile stress rupture and creep behavior of two heats of Incoloy 800 were studied at 615 and 720°C. The two heats differed in C-, Al- and Ti-content. Of the two materials investigated, the alloy which contained Ti and Al and which also had the higher C-content, showed the higher strength, the smaller rupture strains and the more pronounced reduction in time to rupture due to neutron irradiation. From rupture strain and time to rupture, a minimum creep rate was calculated for the unirradiated and irradiated specimens, taking into account the reduction in wall thickness and the increase in diameter during the deformation of a ductile tube under internal pressure. The minimum creep rate of the alloy without Ti and Al was not influenced by neutron irradiation, whereas the alloy with Ti and Al and the higher C concentration showed an increase in minimum creep rate. Moreover, it could be shown that the stress dependence of the minimum creep rate can be described over a wide range by a hyperbolic sine law. (auth)

3188 (INR-1425) METASTABLE INTERMEDIATE PHASES IN THE Sb–Zn AND Sb–Cd SYSTEMS. Chyczewski, M.; Matyja, H. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 23p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.25.

The results of investigation of structure of the Sb–Zn and Sb–Cd alloys rapidly quenched from the liquid state are presented. Effects of rapid quenching found include: increase of Zn and Cd solubility in Sb; formation of the monocrystalline phases in both alloy systems; formation of the π phase of regular cubic structure with a = 3.070 Å in the Sb–Cd system; and formation of the new metastable phase of unidentified structure in the Sb–Zn system. Activation energy of the π phase decomposition was determined.. (auth)

3189 (INR-1441) METASTABLE INTERMEDIATE PHASES IN THE Sb WITH Al, Ga, In, AND IN THE Te WITH Zn AND Cd. Chyczewski, M.; Zielinska, W.; Matyja, H. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 40p. (In Polish). Dep. NTIS (U. S. Sales Only) $4.00.

The results of the investigation of the influence of rapid cooling from the liquid state (at the rates of the order of 10^6 to 10^8 deg/s) on the structure of binary alloys Sb–Al, Sb–Ga, Sb–In and Te–Cd are presented. An increase of solubility of Al and Ga in Sb were

found. The metastable intermediate phases in the Sb–Ga and Sb–In have been obtained. (tr-auth)

3190 (ITF-72-92-P) INELASTIC SCATTERING OF SLOW NEUTRONS BY IMPURITY CRYSTALS. II. Peculiarities of Scattering Cross-Section in the Resonance-Frequency Region of Substitutional Atoms. Dzyub, I. P.; Kochmarskii, V. A. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 40p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

When measuring the double differential cross section of slow-neutron incoherent one-phonon scattering, one can define the frequency distribution function of the impurity crystal. Analysis of the dependence of maxima displacements and width, as well as the shape of a curve of one-phonon peaks on the neutron transfer momentum, yields information about the force-constant change of impurity crystals. This relation becomes especially clear in the case of small force-constant change when, in the vibrational spectrum of the crystal, only one resonant frequency is present. The peak of one-phonon scattering splits in the resonant frequency region. Splitting is caused by the resonance decreasing in the life-time of crystal vibrations described by the plane waves of displacements. Therefore, the dispersion curves defined by maxima of one-phonon peaks suffer from finite discontinuity in the resonance-frequency region. For impurities that lead to decreasing of point symmetry of the defect region, as compared with point symmetry of pure crystal, the splitting of one-phonon peaks is possible due to removal of phonon degeneracy with momenta along with high-symmetry directions. (tr-auth)

3191 (LBL-1174) STRUCTURE AND PROPERTIES OF A NON-CARBON-CONTAINING bcc IRON ALLOY AT ROOM AND ELEVATED TEMPERATURES. Zackay, V. F.; Parker, E. R.; Bhandarkar, D. (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1972. Contract W-7405-eng-48. 23p. (CONF-721064-4). Dep. NTIS $3.25.

From John E. Dorn memorial symposium; Cleveland, Ohio, USA (16 Oct 1972).

A Laves phase, Fe_2Ta, was utilized to obtain good room and elevated temperature properties in an iron-based, carbon-free, bcc alloy containing 1 at. % Ta and 7 at. % Cr. The Fe_2Ta precipitate was spheroidized to enhance room-temperature ductility and toughness; it was stable enough at high temperatures to provide good creep resistance. The alloy had a yield strength of 61,000 psi at room temperature, but the yield strength did not drop precipitously until temperatures in the neighborhood of 1300°F were reached. Stress rupture tests carried out at various constant loads and temperatures indicated that the alloy could withstand reasonably high stresses for long periods of time at temperatures up to about 1100°F. Above about 1100°F, the creep strength dropped to low values. A comparison with the mechanical properties of existing materials indicated that the Fe–Ta–Cr alloy had creep properties superior to many steels currently used in the 600 to 1100°F temperature range. The superior properties were attributed to the stabilization of the matrix substructure by the Fe_2Ta precipitate which is much more stable in this temperature range than the carbides used for strengthening currently used steels. Several heat treatments were investigated in order to optimize properties. Additional alloys are being developed. Some of these are expected to be useful up to 1500°F. (10 figures) (auth)

3192 (N–72-32549) EFFECT OF AGING AT 1040C ON DUCTILITY AND STRUCTURE OF A TANTALUM ALLOY, T-111. Watson, G. K.; Stephens, J. R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Oct 1972. 36p. (NASA-TN-D-6988). NTIS.

The post-aging embrittlement of T-111 (Ta–8% W–2% Hf) following exposure for up to about 10,000 hours at 1040°C in either vacuum or liquid lithium was investigated for sheet and tubing samples. This thermal aging was shown to greatly increase the sensitivity of T-111 to hydrogen embrittlement during subsequent room-temperature specimen processing or testing. The hydrogen embrittlement problem can be avoided by preventing exposure to the T-111 to moisture during post-aging processing or testing. Aging at 1040°C also resulted in formation of HfO_2 particles at grain boundaries, which may contribute to the observed embrittlement. (auth)

3193 (ORNL-TM-4156, pp 16–26) HELIUM EFFECTS IN CTR MATERIALS. Wiffen, F. W. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

The material used in evaluation of the effects of helium content on the creep ductility was Nb–1% Zr and Nb, which contained helium produced both by α injection and by the reaction $^{10}B(n,\alpha)$. The Nb samples were annealed 1 h at 1150°C, the Nb–1% Zr 1 h at 1200°C. The helium concentration achieved in one run was 18 ppM (atomic) and in other run 1.7 ppM. Creep-rupture and fracture elongation data are presented. (MOW)

3194 (ORO-3940-4) THERMOELECTRIC SIZE EFFECT IN NOBLE METALS. Progress Report, May 1, 1972–April 30, 1973. Bourassa, R. R. (Oklahoma Univ., Norman). 1973. Contract AT(40-1)-3940. 11p. Dep. NTIS $3.00.

The thermal voltage and resulting thermopower difference between a 0.1-mil gold foil and a 10-mil gold wire are reported for temperatures between 4.2 and 300°K. The thermoelectric voltage and resulting thermopower difference between a well-annealed aluminum wire and a quenched aluminum wire have been measured from 4 to 150°K for several quench temperatures and two different quench media. The thermopower of aluminum is enhanced by vacancies at temperatures below 70°K and reduced at higher temperatures. The Nielsen–Taylor theory of electron-diffusion thermopower is used successfully to explain the low-temperature enhancement, and the higher-temperature reduction is attributed to phenomenon drag. The thermopower of indium for a 99.999% sample and a 99.9999% sample as a function of temperature is reported. Results on the thermopower difference between 0.3% thallium in indium and pure indium are also presented. (auth)

3195 (RD/B/N-2202) LATTICE AND GRAIN-BOUNDARY DIFFUSION OF MANGANESE IN 20/25/Nb STAINLESS STEEL. Smith, A. F. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Jan 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

Manganese, a major impurity in 20/25/Nb stainless steel, used for canning AGR fuel, plays an important role in the oxidation behavior of this material. Dislocations can theoretically enhance diffusion in cold-worked metals at reactor operating temperatures (below 0.5 T_m) and possible effects of dislocation density on diffusivity of manganese were investigated. From the results it is shown that lattice diffusion in the temperature range 740 to 1250°C can be described by $D_L = 0.21^{+0.19}_{-0.07} \exp[(-59.2 \pm 1.6)/RT]$ $cm^2\ sec^{-1}$ Grain-boundary diffusion in the temperature range 550 to 750°C can be represented by $\delta D_B = (1.1^{+4.0}_{-0.9}) \times 10^{-6} \exp[(46.1 \pm 2.1)/RT]$ $cm^3\ sec^{-1}$. Apparent enhancement of lattice diffusivity occurred below 740°C, but no systematic dependence on dislocation density was observed. It is concluded that, in fine-grained material, grain-boundary effects are likely to dominate at low temperatures. Measurements of dislocation concentration effects can only be carried out on single crystals or large-grained material. (auth)

3196 (Y-1871) MAGNETIC PERMEABILITY AND MECHANICAL PROPERTY MEASUREMENTS ON VARIOUS COLD WORKED STATES OF 316 STAINLESS STEEL. Poore, M. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 27 Mar 1973. Contract W-7405-eng-26. 101p. Dep. NTIS $3.00.

A detailed analysis has been made on 316 stainless steel to determine the effects of cold working on the magnetic permeability and the mechanical properties of the material. After initially characterizing the material, it was cold worked by rolling to several states of cold reduction. These states were approximated in 10% increments from 0% to 50% cold reduction. The mechanical properties of each state were fully determined parallel and perpendicular to the rolling direction. Specimens from each cold-reduced state were also cold worked by tensile deformation. The relative permeability change measured, using an eddy-current phase-sensing technique, was determined for the two forms of cold work and their various combinations. Cold working by rolling only was found to give a larger increase in surface permeability than cold working by tensile deformation. The combination of these two forms of cold work particularly at 30%, 40%, and 50% cold-reduced levels gave the largest increases in permeability. The maximum increase in relative permeability was approximately 4500 ppM, which occurred in the necked portion of a 50% cold-reduced specimen that had undergone 7.5% tensile elongation. In the mechanical properties of the material, an increase was noted in the tensile strength of approximately 85% for the longitudinal and 98% for the transverse tensile specimens taken from the range of 0% to 50% cold reduction. (auth)

3197 INTRINSIC DIFFUSION AND VACANCY WIND EFFECTS IN Ag–Cd ALLOYS. Iorio, N. R. (Westinghouse Electric Corp., Tampa, FL); Dayananda, M. A.; Grace, R. E. Met. Trans.; 4: No. 5, 1339-1346(May 1973).

Diffusion in the Ag–Cd system was investigated at 600°C with vapor/solid and solid/solid diffusion couples in the α-phase for the determination of intrinsic diffusion coefficients, atomic mobilities, and interdiffusion coefficients. Intrinsic diffusion coefficients, D_{Cd} and D_{Ag}, determined experimentally, were compared with those predicted from the models of Darken, Manning, and Dayananda with the aid of tracer-diffusion and thermodynamic data. The experimental coefficients for various alpha alloys were found to be higher than those evaluated from each of the three models. On

the other hand, the experimental values of the ratio, D_{Cd}/D_{Ag}, were found to be in good agreement with the models of Manning and Dayananda where the vacancy wind effects on intrinsic diffusion are taken into account. Darken's relations are considered inadequate to interrelate tracer and intrinsic diffusion coefficients in the Ag–Cd system, since vacancy wind effects are found to be appreciable in this system. (25 references) (auth)

3198 THEORETICAL MODEL FOR ELEVATED-TEMPERATURE DEFORMATION OF DISPERSION-HARDENED METALS. Petrovic, J. J. (Aerospace Research Lab., Wright-Patterson AFB, Dayton, OH); Ebert, L. J. Met. Trans.; 4: No. 5, 1309-1314(May 1973).

A theoretical model is presented to describe the elevated temperature (above $\frac{1}{2}T_m$) deformation of dispersion hardened metals such as TD-nickel and SAP alloys. The model is based on two proposals: 1) Both dislocation glide and climb are influenced by matrix stresses at small, incoherent, second phase dispersed particles produced by surface tension effects at the particle-matrix interface. 2) Two concurrent processes may contribute to the elevated temperature deformation of polycrystalline dispersion hardened metals, dislocation motion and diffusion controlled grain boundary sliding. The model may explain the origins of high apparent activation enthalpies and large stress sensitivities that have been observed in dispersion hardened metals. It may also provide guidelines for optimization of elevated temperature strength. (34 references) (auth)

3199 ELEVATED-TEMPERATURE DEFORMATION OF TD-NICKEL. Petrovic, J. J. (Aerospace Research Labs., Wright-Patterson AFB, Dayton, OH); Ebert, L. J. Met. Trans.; 4: No. 5, 1301-1308(May 1973).

Sensitivity of the elevated temperature (above $\frac{1}{2}T_m$) deformation of TD-nickel to grain size and shape was examined in both tension and creep. Elevated-temperature strength increased with increasing grain diameter and increasing L/D ratio. Temperature sensitivity of the yield stress, as well as high (compared to self-diffusion) apparent tensile activation enthalpies were the result of the internal stress not being proportional to the shear modulus. Creep activation enthalpies increased with increasing L/D ratio and, to a lesser extent, increasing grain diameter, reaching high values which may be apparent values. The thoria particle dispersion may have been altered by elevated-temperature tensile and creep deformation. (auth)

3200 DIFFUSION CREEP BY DISLOCATION CLIMB IN BERYLIUM AND Be–Cu SINGLE CRYSTALS. Le Hazif, R.; Edelin, G.; Dupouy, J. M. (CEN de Saclay, Gif-sur-Yvette, France). Met. Trans.; 4: No. 5, 1275-1281(May 1973).

High temperature creep of beryllium and Be–Cu alloy (10 wt % Cu) single crystals compressed along the $\bar{c}$ axis was shown to proceed by pure climb of $\bar{c}$ dislocations (Burgers vector [0001]). Experimental results can be explained if it is assumed that $\bar{c}$ dislocation loops grow in the basal planes. The activation energy for the climb of the $\bar{c}$ dislocations is found to exceed the activation energy for self diffusion by 10 ± 5 kcal/mole for both beryllium and Be–Cu. This leads to the belief that the $\bar{c}$ dislocation climb rate is controlled by the processes of vacancy emission or absorption at jogs rather than by lattice diffusion. (auth)

3201 SOLID-SOLUTION STRENGTHENING OF HIGH-PURITY NIOBIUM ALLOYS. Sliming, J. R.; Koss, D. A. (Michigan Technological Univ., Houghton). Met. Trans.; 4: No. 5, 1261-1264 (May 1973).

Athermal solid-solution strengthening was examined in substitutional Nb–Hf, Nb–W, and Nb–Ta alloys deformed at 900 K. Ultrahigh vacuum degassed single crystals were tested in compression. The concentration dependence of the yield stress is nearly linear in Nb–Hf and Nb–W alloys for the range of compositions tested (<6 at. %). The rate of hardening with solute addition was the greatest for the Nb–Hf alloys, considerably less for the Nb–W alloys, and the least for the Nb–Ta alloys that exhibited little strengthening. The results indicate that athermal strengthening in these alloys appears to be primarily dependent on the atomic size misfit between solvent and solute atoms and not on the elastic modulus misfit. Results on the slip behavior are also presented. (26 references) (auth)

3202 LOW-TEMPERATURE EMBRITTLEMENT OF NIOBIUM AND VANADIUM BY BOTH DISSOLVED AND PRECIPITATED HYDROGEN. Hardie, D.; McIntyre, P. (Univ. of Newcastle upon Tyne, Eng.). Met. Trans.; 4: No. 5, 1247-1254(May 1973).

Like other exothermic occluders of hydrogen, niobium and vanadium may be embrittled by the presence of a precipitated hydride. However, alloys containing hydrogen concentrations well below the solubility limits at room temperature show very interesting features when tested in tension at subambient temperatures. Niobium containing 25 ppM H, from which little hydride precipitates above 77 K, shows a ductility minimum on cooling which is strain-rate-dependent and my be attributed to diffusion of hydrogen to microcrack nucleation sites. When the hydrogen content is increased a further reduction in ductility occurs at lower temperatures due to the martensitic precipitation of niobium hydride. The behavior displayed by V–H alloys is broadly similar, except that here the influence of hydrogen diffusion overshadows the embrittling effect of the hydride precipitate. This means that the embrittlement associated with hydride precipitation is less easily distinguished from that involving hydrogen in solution in vanadium than in niobium. (24 references) (auth)

3203 MAGNETOTHERMAL OSCILLATIONS AND THE FERMI SURFACE OF VANADIUM. Parker, R. D. Los Angeles; Univ. of Southern California (1973). 114p. University Microfilms Order No. 73-9319.

Thesis (Ph. D.).

The extremal cross-sectional areas of the Fermi surface, and their variations with angle, were measured in pure vanadium using magnetothermal oscillations, and the effective masses of branches near the symmetry directions were determined from the temperature dependence of the de Haas–van Alphen effect. The experiments were conducted in fields of up to 110 kOe between 1.11°K and 4.2°K. The measured extremal areas were consistent with a description of the Fermi surface as qualitatively similar to those found for niobium and tantalum. The waveshape of the magnetothermal oscillations was analyzed using computer techniques. It was found that fitting the waveshapes to the theoretical equation provided believable values for the electronic g factor and the Dingle temperature if the mass was known, and it proved possible to determine these two parameters to an accuracy of better than 10%. (DLC)

3204 CHANGES IN FERMI SURFACE, ELECTRON SCATTERING TEMPERATURES, AND MAGNETIC BREAKDOWN OF ANNEALED AND AGED DILUTE ZINC–CADMIUM ALLOYS. Park, J. K. Cleveland; Case Western Reserve Univ. (1972). 180p. University Microfilms Order No. 73-6329.

Thesis (Ph. D.).

The de Haas–van Alphen (dHvA) effect was used to determine the concentration-dependent changes in two portions of the zinc Fermi surface in supersaturated solid solutions of cadmium up to 1.2 at.%. The torque method was used in field up to 35 kG. Results for extremal cross sections, cyclotron masses, and scattering temperature were used with similar measurements in aging samples to explore matrix changes during intermediate and final states of precipitation. Resistivity data during aging fit a standard nucleation and growth model of coherent cadmium cluster formation and, in comparison with dHvA frequencies, indicate a net unidirectional strain along [0001] in the matrix. A rapid increase of effective scattering temperature implies dHvA phase smearing due to large fluctuations in matrix strain and concentration. Strain seems to be the primary factor here as expected from the large mismatch between cadmium and zinc lattice constants. A Lorentzian distribution of phase smearing was used. While it is consistent with the data, a Gaussian distribution was not ruled out. Electron microscopy of the fully precipitated material shows rod-like particles (typically 100 Å × 200 Å × 1000 Å) with rod axes lying in the basal plane. Both resistivity and dHvA frequencies are consistent with a low cadmium concentration in the matrix (~0.03 at. %) and with no net strain. The range of electron orbit sizes is approximately that of the particle and of their separations. Magnetic breakdown results on the needle oscillation fit the usual Pippard expression for the annealed alloys with H_0 increasing with concentration and exhibiting a cos θ dependence on the angle between H and [0001]. During the intermediate and final stages of aging, the field dependence deviated from the standard expression with a clear indication that the appropriate H_0 is greater than a pure zinc value expected in the precipitated case. (Diss. Abstr. Int., B)

3205 DYNAMIC STRAIN AGING DURING CREEP OF α-Zr. Warda, R. D. (Univ. of British Columbia, Vancouver); Fidleris, V.; Teghtsoonian, E. Met. Trans.; 4: No. 5, 1201-1206(May 1973).

In the temperature range 723 to 823 K (450° to 550°C) annealed, crystal bar α-Zr exhibits anomalous behavior with respect to both single stress and incrementally stressed creep tests. The nature and extent of the anomalous behavior depends on temperature, stress, and impurity content. Specimens with low oxygen content exhibit: 1) normal, three-stage creep behavior during single stress tests, and 2) normal transients during incremental stress and temperature tests. Specimens with higher oxygen contents exhibit: 1) multistage creep curves whose shapes depend on temperature and stress, 2) inverse transients following stress and temperature increments, and 3) peaks in activation energy-temperature curves. The nature of the anomalous behavior is consistent with a model for strain aging in which the possibility of localized depletion of the strain-aging species exists. In the material being studied oxygen is

probably responsible for the observed effects. (29 references) (auth)

3206 RADIATION-INDUCED STRENGTHENING AND EMBRITTLEMENT IN ALUMINUM. Farrell, K.; King, R. T. (Oak Ridge National Lab., TN). Met. Trans.; 4: No. 5, 1223-1231(May 1973).

Commercially pure aluminum (1100 grade) in the annealed condition was irradiated to fast fluences in the range 1 to 3×10^{26} neutron/m^2 (E > 0.1 MeV) and to similar thermal fluences at temperatures of 318 to 328 K, and was then tensile tested at temperatures between 298 and 643 K. This irradiation doubled the ultimate tensile strength and more than tripled the flow stress at all test temperatures. The work hardening exponent was severely reduced and there was a large loss in ductility. Strengthening is shown to be due to a fine precipitate of transmutation-produced silicon and an associated dislocation structure. At test temperatures below about 423 K the fracture mode was transgranular. Above 473 K, grain-boundary cavities were observed, the fracture mode became predominantly intergranular, and ductility was further reduced. Unirradiated specimens containing cyclotron-injected helium showed no change in strength but displayed a loss in ductility at elevated temperatures. Concurrently, holes were formed on the grain boundaries. Embrittlement in the neutron-irradiated specimens arises from two sources. One is through the defect structure which reduces the work-hardening exponent. The other is an additional effect at elevated temperatures involving grain-boundary failure by cavity growth and coalescence. Helium encourages cavity nucleation, the degree of cavitation increasing with increasing tensile strength. (39 references) (auth)

3207 LOW-TEMPERATURE MICROCREEP IN NIOBIUM SINGLE CRYSTALS. Bluem, M. F. Urbana, IL; Univ. of Illinois (1972). 136p. University Microfilm Order No. 73-9882.

Thesis (Ph. D.).

The activation volume,thermal activation enthalpy, and total activation enthalpy were measured from 5 to 310°K during microcreep of pure and doped niobium single crystals. Results are discussed in terms of dislocation motion past short-range obstacles through the combined effect of applied stress and thermal activation. The activation volume ranges from 0.3 b^3 at 5°K to 200 to 10,000 b^3 at 310°K, with little variation from changes in composition or prestrain. Total activation enthalpy increases monotonically with temperature reaching 1.3 eV at 200°K independent of composition or prestrain. Above 200°K, ΔH_0 does not rise as rapidly in the pure material as in the doped material. These data do not show good quantitative agreement with models based on activation past impurity defects or Peierls barriers, although agreement with predictions of a model based on the sessile to glissile activation of the dislocation core indicates this mechanism has an influential role. However, the activation parameters indicate no single barrier controls microcreep. The measured parameters are averages of the parameters of more than one type of barrier. (Diss. Abstr. Int., B)

3208 LOW-TEMPERATURE PROPERTIES OF ALUMINUM–RARE EARTH ALLOYS. Archibald, M. A. A. Urbana, IL; Univ. of Illinois (1972). 133p. University Microfilms Order No. 73-9868.

Thesis (Ph. D.).

Measurements of electrical resistivity, magnetic susceptibility, and superconducting critical temperature were carried out on dilute alloys of several rare earth elements (Ce, Eu, Er, Tm, Yb) with aluminum. Conclusions are drawn on the valencies, solubility limits, and magnetic states of these impurities in aluminum. It appears that for the magnetic rare earths, the 4f levels may be described by an ionic model in aluminum, with the possible exception of AlCe, which may be a Kondo system. The low temperature, zero-field susceptibilities of the intermetallic compounds $EuAl_4$, $YbAl_3$, and Ce_3Al_{11} were also measured. The resistivity of the latter compound, which exhibits complex magnetic orderings, was studied from 10°K to below 0.1°K. Temperatures below 1°K were attained with a dilution refrigerator. The construction of this cryostat, as well as the magnetic susceptibility apparatus and the various types of thermometers employed, is discussed in detail. (Diss. Abstr. Int., B)

3209 SIMPLE MODEL FOR THE STUDY OF MAGNETISM IN TRANSITION-BASED ALLOYS WITH ACTINIDE IMPURITIES. Jullien, R.; Galleani d'Agliano, E.; Coqblin, B. (Paris Univ., Orsay, France). J. Low Temp. Phys.; 10: No. 5-6, 685-705 (Mar 1973).

A simple model taking into account a 6d and a 5f virtual bound state and describing spin–orbit effects for the 5f electrons is developed in order to explain the magnetic properties of actinide impurities in transition metals, especially the occurrence of magnetism for neptunium and plutonium. The model can account for the decrease of the superconducting temperature of lanthanum-based alloys with actinide impurities from thorium to americium. (36 references) (auth)

3210 IN SITU DEFORMATION OF MOLYBDENUM THIN FOILS. Vesely, D. (Oxford Univ.). J. Microscopy; 97: No. 1-2, 191-196(Jan 1973).

Thin foils of pure molybdenum single crystals with selected surface orientations and tensile axes were tested on a double-tilt straining stage using a microscope operating at 800 keV. Studies were made of the propagation of screw and edge dislocations, slip geometry, dislocation multiplication, and formation of dislocation tangles. Special attention was paid to the influence of the surface on dislocation motion and the comparison of observed effects with those of bulk material. (auth)

3211 DISLOCATION STRUCTURE IN MOLYBDENUM SINGLE CRYSTALS AFTER DEFORMATION AT 293° AND 400°K. Vesely, D. (Oxford Univ.). Phil. Mag.; 27: No. 3, 607-621(Mar 1973).

Molybdenum single crystals, oriented for slip on $(\bar{1}01)(111)$, were deformed in tension at 293 and 400°K. Thin foils parallel to the primary and conjugate slip planes were examined under the electron microscope. The development of dislocation structures with strain, dislocation densities, Burgers vectors, and dislocation walls were studied. The changes in the dislocation structure are discussed in terms of the temperature- and stress-dependent cross slip of screw dislocations. The multiple slip at the beginning of deformation and single slip in the region of easy glide are explained on the assumption that surface sources are active in stage 0 and internal sources in stage I. (auth)

3212 PRE-MACRO YIELDING AND ORIENTATION DEPENDENCE OF SHEAR STRESS IN MOLYBDENUM SINGLE CRYSTALS. Pink, E. (Erich-Schmid-Institut fuer Festkoerperphysik, Leoben, Austria). Phys. Status Solidi (a); 16: No. 2, 633-639(16 Apr 1973).

The orientation dependence of the "shear" stress of molybdenum single crystals is reviewed in terms of activation volumes and dislocation structures. It is concluded that the definition of the shear stress is of importance for the observation of an orientation effect: if a macroyield point beyond which the activation volume remains strain-independent is chosen as the shear stress, no orientation dependence can be resolved within the limits of scatter of the method. (5 figures, 28 references) (auth)

3213 TANTALUM: THE MULTI-PURPOSE METAL. Schussler, M. Precis. Metal; 30: No. 11, 64-66(Nov 1972).

Tantalum and Ta-based alloys are used in porous anodes, chemical process equipment, furnace parts, wire springs, filament supports, fasteners and liquid metal containment. A table lists the density, melting point, bend transition temperature and tensile properties of Ta and some of its alloys. Recommendations for forming, machining and welding are given. (Metal Abstr.)

3214 AUTORADIOGRAPHY IN RADIOTRACER ADSORPTION STUDIES ON METAL SURFACES. Sahu, T.; Mishra, I. S.; Das, S. K. (Fertilizer Corp. of India Ltd., Sindri). Technology (Sindri); 9: No. 1, 60-61(1972).

The use of autoradiography to study the adsorption characteristics of ^{59}Fe on mild steel and aluminum as a function of time is discussed. (auth)

3215 EFFECTS OF HYDROGEN AND OTHER INTERSTITIALS ON THE LOW-TEMPERATURE RELAXATION OF DEFORMED VANADIUM. Chang, H. Y.; Wert, C. A. (Univ. of Illinois, Urbana). Ber. Bunsenges. Phys. Chem.; 77: No. 1, 42-48(1973).

Three damping peaks in V are reported which were caused by dislocation motion constrained by several types of atmospheres. Deformed wires of pure V showed a well-known damping peak called the α peak. This peak is presumed to be caused by depinning of dislocations by an oscillatory stress. Increases in immobile oxygen or nitrogen atoms gradually suppress the peak. Hydrogen, which forms a mobile atmosphere, produces two additional peaks of the Snoek–Koester type. These latter peaks can result from either externally imposed deformation or from internal deformation produced by misfit of precipitated hydrides. (GF)

3216 NEW METHOD OF THERMOGRAPHIC INVESTIGATION OF FAST PROCESSES OF REFRACTORY METAL CRYSTALLIZATION. Kashin, V. I.; Svet, D. Ya.; Afon'kin, V. G.; Klibanov, E. L.; Semenov, V. G. (Inst. of Metallurgy, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 1, 81-82(1 Nov 1972). (In Russian).

A study of crystallization of molten metal in a vacuum and in a controlled atmosphere showed that changes in the coefficient of

emissive capability may be eliminated in pyrometric methods according to the relative distribution of the spectral density of radiation energy. Samples of tungsten were melted, the temperature being measured with an optical-electronic sensing element of an automatic two-wave photoelectronic pyrometer that had been redesigned for recording the temperatures of fast-acting processes. Pairs of voltage impulses, proportional to the spectral radiance, with a frequency of 50 Hz were fed to an oscillograph, and recorded with a motion-picture camera. Crystallization of the W under Ar or He was readily followed with the apparatus described in the temperature range 3600 to 3000°C. (KSW)

3217 RENTGENOVSKAYA EMISSIONNAYA SPEKTROSKOPIYA METALLOV I SPLAVOV. (X-ray-emission Spectroscopy of Metals and Alloys). Nemoshkalenko, V. V. Kiev; Naukova Dumka (1972). 319p.

The book deals with basic results obtained in the field of x-ray-emission spectroscopy of metals (light sp metals and d metals). The hybridization of different symmetry states in an external energy band being large, it is possible to determine the valence band width and electron distribution according to different symmetry states within it by combining bands obtained with different symmetry of the inner scanning level. For transition metals (d metals), a model of the electronic structure is constructed which not only explains their x-ray-spectral characteristics but also corresponds to their electronic properties. X-ray-spectral characteristics and electronic structure are considered in detail for intermetallic compounds formed in alloys of transition metals with aluminum. An essential difference is shown in electronic structure of alloys of aluminum with transition metals of the beginning and end of large periods. Considerable electron transfer from aluminum atoms to the transition metal atoms on filling their d-shell proved to take no place in the alloys of the first type. In the alloys of the second type, the additional building of the transition metal d-shell occurs not only at the expense of electron transfer from aluminum atoms to the transition metal ones, but also at the expense of s- and p-symmetry electrons located in the neighborhood of the transition metal atoms. X-ray-spectral characteristics are also considered for intermediate phases in alloys of transition metals, such as σ phases, Laves phases, and CsCl type phases. Of the numerous alloys forming the σ-phase, only the alloys with vanadium and chromium are studied. The degree of overlapping external energy bands and character of combining valence electrons in them are sharply different. The valence band structure of these alloys is studied and the character of electron transfer between the atoms of their components is determined. Essential effect of electronic factors on formation of Laves phases is found. An author index is included. 402 references. (DLC)

3218 ELECTRICAL RESISTIVITY OF SINTERED TUNGSTEN–RHENIUM ALLOYS. Vertogradskii, V. A.; Chekhovskoi, V. Ya. (All-Union Scientific-Research Inst. of Aviation Materials, Moscow). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 10, 829-830(Oct 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 10, 68-70(Oct 1972).

Electric resistivity of alloys with Re contents of 5, 10, 19, 20, 21, and 27 wt % was studied within a temperature interval of 1200 to 3000°K. Applicability of the Nordheim law (proportionality of electric resistivity to the product of the component atomic concentrations) was established, except for the range of 20% Re at temperatures higher than 1700°K. In this range, a decrease in electric resistivity (~5%) was found at 2800°K for part of the samples. (auth)

3219 SATURATED LIQUID DENSITY OF ALKALI METALS. Watson, E.; Stronski, R. E. (Saint Joseph's Coll., Philadelphia). Inorg. Nucl. Chem. Lett.; 9: No. 5, 591-594(May 1973).

Results of an investigation into the applicability of the equation given by Agrawal and Thodos (Phys. Chem. Liquids, 2: 135(1971)) for cryogenic fluids to density–temperature data for liquid Cs, Rb, and Na are given. This relationship is $\rho_R = 1 + k\,(1 - T_R)^{\beta}$, where ρ_R and T_R are the reduced saturated density and temperature, respectively, and k and β are constants for a given series of fluids. It was found that the relationship appears to describe the saturated density–temperature behavior of the alkali metals over a large temperature range up to the region of the critical point. (UK)

3220 DIFFUSION ANOMALY IN SOME BCC TRANSITION METALS. Tiwari, G. P.; Raghunathan, V. S. (Bhabha Atomic Research Centre, Trombay, India). Trans. Indian Inst. Metals; 25: No. 1, 43-49(Mar 1972).

Some bcc transition metals like β-Zr, β-Ti, and V are known to exhibit a nonlinearity in the log D vs 1/T plots of their self- and impurity-diffusion data. Recently, a number of bimodal diffusion mechanisms, in which different exchange processes are believed to operate in different temperature ranges, have been proposed to explain such results. Present paper gives a critical review of these mechanisms. The possibility of a self-consistent explanation for "anomalous" diffusion based on the intrinsic property changes like temperature dependence of elastic constants etc, is also discussed. Some experimental evidence on mass transfer in these metals in the "anomalous" temperature range is also presented. (6 figures, 37 references)

3221 INTERMEDIATE PHASES IN SOME RARE EARTH–RHODIUM SYSTEMS. Ghassem, H.; Raman, A. (Louisiana State Univ., Baton Rouge). Z. Metallk.; 64: No. 3, 197-199(1973).

Phase equilibria and crystal structures of intermediate phases in the rare earth–Rh systems of the rare earths Ce, Sm, Gd, Tb, Y, and Dy were investigated using the powder x-ray diffraction technique. The systems are rich in intermediate phases. The Th_7Fe_3- and the $MgCu_2$-type are the only structures that occur in all the Ln–Rh systems. The other structures occur in the systems of either the light rare earths or the heavy rare earths. The occurrence of the various crystal structures in the Ln–Rh systems is analyzed. (GF)

3222 STABLE ELECTRONIC CONFIGURATION MODEL AND ITS ROLE IN METALLURGY. Upadhyaya, G. S. (Univ. of Roorkee, India). Trans. Indian Inst. Metals; 24: No. 4, 48-55(Dec 1971).

Various electronic configuration models of solids are reviewed and the model proposed by Samsonov is discussed in detail. It is proposed that stable electronic configurations for transition d metals according to the degree of descending energy stability are d^5, d^{10}, and d^0. In case of nonmetals characterized by sp-valence electrons, the energetic stability of $s^x p^y$ configurations increases in the order s^2p-sp-sp^2-sp^3-s^2p^6. For s elements the stable configuration is s^2. A simple relationship to calculate the statistical weight of atoms with stable configurations (SWASC) for d-elements is put forward. The model is successfully applied in revealing the nature of equilibrium diagram and phase stability, crystal defects, diffusion, liquid metal properties, and some technological properties like metal cutting. The model goes a step further in systematizing the nature of change in properties, which unfortunately could not be solved by band theory adequately. (4 tables, 6 figures, 41 references) (auth)

3223 RECRYSTALLIZATION OF TUNGSTEN WIRE. Kostkowski, A.; Nowar, W. Rudy Metale Niezelaz.; 18: No. 2, 85-89 (1973). (In Polish).

The recrystallization process of tungsten wire was investigated using microhardness measurements and microscopic examinations. An arrest was found on the curve representing decrease in mechanical properties with rising temperature. This arrest (previously found by Davis) occurs immediately after completion of primary recrystallization. An attempt was made to determine the degree of recrystallization from the microhardness distribution on the cross section of the investigated sample. (auth)

3224 DOMAIN STRUCTURES AND HARDENING IN ORDERED Ni_4Mo. Irani, R. S.; Ling, F. W.; Cahn, R. W. (Univ. of Sussex, Brighton, Eng.). Metallography; 6: No. 2, 141-153 (Apr 1973).

An investigation was carried out to reveal domain morphologies on an optical scale in the ordered alloy Ni_4Mo. This particular superlattice has a tetragonal structure and because of its optical activity, has made it possible for plane-polarized light to be employed to detect the development of the ordered phase. Apart from discussing the nature and origin of the contrasts present, an interpretation is forwarded to account for the range of different types of microstructures which were observed. The actual morphology was found to be strongly dependent on the temperature at which ordering was performed. The resultant internal strains within the material have played a predominant part in governing the alloy's microstructure. Using this macroscopic approach, it proved possible to correlate the mechanical strength of Ni_4Mo (measured by means of microhardness tests) and the prevalent morphology. (auth)

3225 THERMAL CYCLING OF COPPER MATRIX–TUNGSTEN FIBER COMPOSITES: A METALLOGRAPHIC STUDY. Chawla, K. K. (Instituto Militar de Engenharia, Rio de Janeiro). Metallography; 6: No. 2, 155-169(Apr 1973).

Composite specimens, consisting of tungsten fibers embedded in a single-crystal copper matrix, were subjected to thermal cycling. Stresses arose in the two components due to the differential in the coefficients of expansion of fiber and matrix; the ones arising in the soft copper matrix were large enough to cause plastic flow. The extent of plastic deformation in the copper matrix, as evidenced by the slip markings, was higher immediately next to the fiber/matrix interface and it increased with the number and amplitude of thermal cycles. For a given magnitude of temperature change, the extent of slip deformation

in the matrix was higher for high rate cycling than for slow rate cycling. In the as-made condition the dislocation density in the copper matrix was higher close to the fiber/matrix interface than far away from the fiber. On thermal cycling this dislocation density gradient evened out. A well-defined cell structure developed after slow-rate cycling between ambient and up to 300°C. The well-defined cell structure was conspicuous by its absence after high rate cycling between ambient and liquid nitrogen temperature. The matrix behavior is discussed in relation to the thermal stresses generated and the initial and final dislocation distributions. (auth)

3226 CALCULATION OF THE MECHANICAL STABILITY OF THE CRYSTAL LATTICES OF IRON, MOLYBDENUM, AND TUNGSTEN. Zhdanov, V. A.; Konusov, V. F.; Zhukov, A. V. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 74-78(1972). (In Russian).

A semi-empirical tensor equation of state was obtained for Fe, Mo, and W and used in the examination of the mechanical properties of their crystal lattices under conditions of complex stress systems. The most dangerous systems of stress are evolved; limiting stresses and deformations are calculated. The strength values thus found were in good agreement with existing values. (tr-auth)

3227 RELATIONS BETWEEN STRUCTURE AND MAGNETIC PROPERTIES OF $LnPt_5$ PHASES. Lueken, H.; Bronger, W. (Technische Hochschule, Aachen). Z. Anorg. Allg. Chem.; 395: No. 2-3, 203-206(Jan 1973). (In German).

In the series of the $LnPt_5$ phases from lanthanum to thulium, different structure types were observed. The change of the atomic arrangement in the structure types is related to steps in the diagram of the atomic volumes of the Ln atoms according to the lanthanide contraction. Measurements of the magnetic moments show the stabilization of lower oxidation states like Ce^{3+}, Nd^{2+}, and Eu^{2+} according to the large holes in the platinum lattice. (auth)

3228 THERMODYNAMIC PROPERTIES OF THE NICKEL-TUNGSTEN SYSTEM AS DETERMINED FROM ITS HYDROGEN SOLUBILITY. Lange, K. W. (Technische Hochschule, Aachen). Z. Metallk.; 64: No. 2, 111-112(1973). (In German).

The concentration dependence of the integral molar excess free enthalpy, the activities, and the activity coefficients of nickel and tungsten in the nickel-tungsten system are computed in terms of equations from the solubility of hydrogen in this system. Both components exhibit negative deviations from Raoult's law in the nickel-rich part. The components behave increasingly ideally with increasing temperature. The excess free enthalpy of mixing is negative. (tr-auth)

3229 MAGNETIC SUSCEPTIBILITY IN ALLOYS OF THE Bi-Cd SYSTEM. Kuz'menko, P. P.; Suprunenko, P. A.; Kal'naya, G. I.; Kotikova, T. D. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 2, 222-226(Feb 1973). (In Russian).

Results are presented of studying temperature and concentrational dependences of magnetic susceptibility in alloys of the Bi-Cd system in the range of solid and liquid states. Magnetic susceptibility of hard alloys (at 20°C) is in linear dependence on the composition; for liquid alloys concentrational dependence $\varkappa$ deviates from the mixing law. A possible reason of the latter is supposed to be a decrease in density of conduction electrons state at the Fermi level in Bi-Cd melts. (tr-auth)

3230 CHANGES IN LATTICE PARAMETER OF VANADIUM AND CHROMIUM THIN FILMS. Gladkikh, N. T.; Pesin, A. I.; Protsenko, I. E.; Chekarev, M. A. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 2, 208-212(Feb 1973). (In Russian).

It is shown that the lattice parameter of vanadium and chromium films prepared in vacuum of $\sim 10^{-8}$ torr decreases with a decrease in their thickness, and of that of films prepared in vacuum of $\sim 10^{-5}$ torr increases with a decrease in the thickness. Surface energy of vanadium (2200 erg/cm^2) and chromium (1900 erg/cm^2) at room temperature is determined from the change in the lattice parameter of the films prepared in vacuum of $\sim 10^{-8}$ torr. (tr-auth)

3231 STRUCTURE AND ELECTRICAL CONDUCTIVITY OF INDIUM-THALLIUM ALLOYS IN LIQUID STATE. Romanova, A. V.; Il'inskii, A. G.; Pavlova, E. A. (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 263-371(Mar 1973). (In Russian).

An x-ray study for liquid In-Tl alloys was made, beginning from 10, 35, and 80 at.% Tl corresponding to three types of crystal lattices (hct, hcc, bcc) in temperature ranges 160 to 300°, 170 to 300, and 270 to 300°C, respectively. A detailed analysis of peculiarities in scattering intensity curves, atom radial distribution curves, and experiments on studying structure of solid samples with variations in methods of heating and cooling showed that the melts possess a high structural heterogeneity. Microregions with packings of hcc, bcc, and hcp-lattice types may be formed in a liquid state. Formation of microregions of great dimensions of hcp type is most likely to be associated with an orienting influence of the oxides' thin film. Electric conductivity was measured in the above-mentioned alloys as well as in the alloy In-Tl with 90 at.% Tl by the method of a rotating magnetic field to a temperature 1000°C. Regularities of changes in electric conductivity are in good agreement with the x-ray-diffraction data. (tr-auth)

3232 EFFECTS OF NIOBIUM ON THE PROPERTIES OF WELDED JOINTS. Ornichev, S. I.; Savchenkov, V. A.; Lipskii, N. I. (Scientific Research Inst. for Metals, Kiev). Weld. Prod. (USSR) (Engl. Transl.); 19: No. 4, 51-56(Apr 1972).

Translated from Svar. Proizv.; 19: No. 4, 30-33(Apr 1972).

The effects of additions of niobium on the properties of welded joints and on the resistance of weld metal to hot cracking were investigated. The research was performed using specimens of 10-mm thick steel plate, to which niobium had (18B steel) or had not been added. The specimens were welded with UONI-13/55 electrodes the coatings of which included: niobium pentoxide in the as-supplied state, in the form of RETU1296-66 powder (containing 69.5% Nb) and ferroniobium supplied under MPTU2735-51 (containing 49.0% Nb). Results show that when weld metal is alloyed with up to 0.03% of niobium, its strength properties are increased but its impact strength is slightly lowered. Increasing the niobium content greatly lowers the impact strength but greatly increases the other strength properties. Niobium has an effect on the resistance of weld metal to hot cracking, this effect depending on the structure caused by the amount of niobium introduced. Niobium pentoxide can be used for alloying welds as a substitute for FeNb; without causing any deterioration in the properties of electrodes in respect of the welding technology; the pentoxide provides good quality welded joints. (JCW)

3233 RELATIVISTIC LOW-ENERGY ELECTRON DIFFRACTION FROM W(001). Feder, R. (Univ. of Cape Town). Phys. Status Solidi (b); 56: No. 1, K43-K45(1 Mar 1973).

Intensities and spin polarizations of different beams for the case of an unpolarized beam incident normally upon W(001) with energies from 0 to 40 eV were computed. Nine beams were taken into account. The polarization is of the same sign over the entire energy range and exhibits only two peaks, one of 54%, the other of 6%. It is noted that both polarization peaks are associated with intensity minima, which is a feature well known in atomic scattering. Since inelastic damping by the valence electrons reduces the effect of multiple scattering, while leaving the spin polarizations due to the individual muffin-tin spheres unaltered, the strong inelastic limit will yield the polarization values characteristic of a single muffin-tin sphere. Although the present computations involve several simplifying assumptions, they appear to satisfy the currently available limited experimental data adequately. To obtain results, which will agree quantitatively with future measurements, in particular of the spin polarization, it appears to be essential to include a realistic surface barrier as well as a more adequate imaginary potential with particular emphasis on inelastic surface modes. Both can be incorporated readily in the formalism used. (auth)

3234 DISLOKATSII I TOCHECHNYE DEFEKTY V GEKSAGONAL'NYKH METALLAKH. (Dislocations and Point Defects in Hexagonal Metals). Predvoditelev, A. A.; Troitskii, O. A. Moscow; Atomizdat (1973). 201p.

The nature and properties of defects in the crystalline structure of hexagonal metals constitute the subject matter of this monograph. Experimental methods of investigating dislocations and point defects, and the mechanisms involved in the plastic deformation of metals are described. Theoretical and experimental data on the influence of free electrons in a metal on its mechanical properties are adduced. Of the 20 metals commonly listed as possessing hexagonal close packing in the solid state, those of particular interest here are Be, Sc, Y, Zr, Cd, Tb, Dy, Ho, Tm, Lu, Hf, Re, and Tl. In addition, some tables of data include In. 419 references. (KSW)

3235 MAGNETIC SUSCEPTIBILITY OF LAVES-PHASE $HfCo_2$ IN THE SINGLE-PHASE REGION. Aoki, Y.; Nakamichi, T.; Yamamoto, M. (Tohoku Univ., Sendai). Phys. Status Solidi (b); 56: No. 1, K17-K20(1 Mar 1973).

Alloy specimens containing 27.1 to 35.0 at. % Hf were arc-melted three times in an argon atmosphere using electrolytic cobalt of 99.86% purity and hafnium sheet of 99.9% purity. Powder specimens for the x-ray study and bulk specimens for the buttons homogenized at 1000°C for 96 h in vacuum, were re-annealed at 1000°C for 48 h in evacuated quartz ampuls and followed by water quenching because of the security of the wider single-phase region. It was found that the 27.1 and 28.1 at. % Hf alloys are a mixture of the paramagnetic compound $HfCo_2$ and the ferromagnetic phase with a Curie point of about 150°C which is probably due to $HfCo_9$.

The single-phase region of the $MgCu_2$ type $HfCo_2$ ranges from about 28.5 (a = 6.862 Å) to 33⅓ at. % Hf (a = 6.919 Å). The 34.1 and 35.0 at. % Hf alloys are in two-phase region of the $MgCu_2$ type $HfCO_2$ and the CsCl type HfCo. The composition dependence of the paramagnetic Curie point (θ) seems to reveal that the combined strength of the antiferromagnetic and ferromagnetic interactions depends on the amounts of the existing excess Co atoms through the formation of the nearest neighbor excess Co-excess Co pairs. As a result, these magnetic properties are very similar to those observed previously in the $MgCu_2$ type $ZrCo_2$ compound. (auth)

3236 HEAT TREATMENT OF BERYLLIUM–COPPER ALLOYS. II. Solution Heat Treatment of BeCu Alloys. Wikle, K. G. Ind. Heat.; 39: No. 10, 1814-1816(Oct 1972).

Recommendations are given for the solution treatment of both high-strength and high-conductivity cast and wrought alloys of BeCu in large and small sections. Graphs show the effect of solution heat-treatment temperature on as-quenched and aged tensile strengths of 0.625-in.-thick BeCu plate. (Metals Abstr.)

3237 HEAT TREATMENT OF BERYLLIUM–COPPER ALLOYS. I. Heat Treat Process. Wikle, K. G. Ind. Heat.; 39: No. 9, 1641-1646; 1648(Sep 1972).

Beryllium–copper alloys respond to precipitation hardening to such a degree that their strength and hardness compare with values for some heat-treated steel. The various heat treatments applied to Be–Cu products include precipitation hardening by solution heat treatment or aging, homogenizing of castings, stress relieving, homogenizing, wire "annealing," and mill hardening. Hardening mechanisms are compared for alloys with various Cu and Be contents and for alloys with additions of Co and Ni. (Metals Abstr.)

3238 THERMAL CONDUCTIVITY OF A NUMBER OF ALLOYS AT ELEVATED TEMPERATURES. Tye, R. P.; Hayden, R. W.; Spinney, S. C. (Dynatech Corp., Cambridge, MA). High Temp.–High Pressures; 4: No. 5, 503-511(1972).

Thermal conductivity and electrical resistivity measurements were carried out using an absolute axial rod method up to 1200°K upon a number of commercial and special alloy materials to be used primarily for space applications. Determinations were made for some materials on a number of different samples of the same nominal composition. These include a copper–boron material, a 304 stainless steel, Inconel 718, A286 (an iron-based superalloy), alloy TZM, and a molybdenum–0.5% titanium alloy. For some high- and low-copper-based alloys, measurements were carried out on one sample only. The agreement obtained on different samples of the same material indicates that the accuracy of measurement is better than ±3% over the whole range. This was confirmed by measurements upon a sample of the original Powell (1934) Armco iron. Results together with the Lorenz number are presented and compared with other available data. For some of the copper alloys, a maximum in thermal conductivity was obtained at temperature corresponding to where metallurigical changes occur. The maximum is accompanied by a rapid change in electrical resistivity which keeps the Lorenz number constant. The thermal conductivity behaviour is shown to be predictable from the Smith–Palmer equation and indicates that use of this equation can be extended to much higher temperatures. (auth)

3239 STATISTICAL STUDY OF THE KINETICS OF NUCLEUS FORMATION IN MELTS. II. Effect of Preliminary Heat Treatment and Rate of Cooling on the Rate of Nucleation of Crystallization Centers in Indium Antimonide and Germanium Melts. Dem'yanov, E. A.; Bolkhovityanov, Yu. B.; Kidyarov, B. I. Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 10, 1458-1460(Oct 1972).

Translated from Zh. Fiz. Khim.; 46: No. 10, 2541-2544(Oct 1972).

The variation of the rate of nucleation of crystallization centers in indium antimonide and germanium melts of semiconductor degree of purity was investigated for different degrees of superheating different cooling rates. There is a discrete series of temperatures at which termination of the metastable liquid state is most likely (degrees of supercooling of 10 to 13, 19 to 22.5, and 28 to 33° for indium antimonide and 6 to 9, approximately 28, and 36 to 41° for germanium). The positions of the maxima remain unchanged and their height depends to a considerable degree on the thermal history of the melt. The results of the study are not consistent with the theory of heterogeneous nucleus formation, but they are consistent with a number of other studies. (auth)

3240 EXPERIMENTAL DETERMINATION OF THE FUSION ENTHALPIES OF URANIUM AND BERYLLIUM. Radenac, A.; Berthaut, C. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). High Temp.–High Pressures; 4: No. 5, 485-491(1972). (In French).

The transformation and fusion enthalpies of pure uranium and pure beryllium were determined as part of a study of the heat of formation of uranium–beryllium compounds. A calorimeter described previously was used, and the samples were kept in sealed containers in view of their strong reactivity at high temperature. The experimental method is briefly described and results are given and compared with published data. (auth)

3241 ANISOTROPY OF CLEAVAGE IN BCC TRANSITION METALS. Tyson, W. R. (Trent Univ., Peterborough, Ont.); Ayres, R. A.; Stein, D. F. Acta Met.; 21: No. 5, 621-627(May 1973).

The problem of predicting the favored cleavage plane in bcc metals is considered in the light of existing theories of crack propagation. It is shown that both {100} and {110} are likely cleavage planes in the absence of plastic deformation, but that plastic work is least for a {100} crack. The predictions are compared with experimental observations. (auth)

3242 ANALYSIS OF LOW-TEMPERATURE CREEP AT CONSTANT LOAD. Yaroshevich, V. D.; Vladimirova, G. V. (Ioffe Inst. of Physics and Tech., Leningrad). Acta Met.; 21: No. 5, 691-694(May 1973).

Low-temperature creep of solids at constant load is studied in terms of thermally activated process. It is shown that even if the process rate is controlled by only one mechanism of plastic deformation (in particular, the model of cutting forest dislocations is considered), the creep curve begins with a portion of accelerating flow followed by the stage of decreasing strain rate, which turns into the stage of the infinitely increasing flow. Analytically it is also shown that irrespective of the magnitude of the applied stress and the test temperature at P = Const, the terminal creep stage is preceded by a certain critical amount of strain, ϵ_{crit}. The results obtained are compared with the experimental data available. (auth)

3243 THERMALLY ACTIVATED DEFORMATION IN HAFNIUM. Dasgupta, P.; Arunachalam, V. S. (Bhabha Atomic Research Centre, Trombay, India). Trans. Indian Inst. Metals; 25: No. 3, 32-35(Sep 1972).

Deformation mechanisms operating in polycrystalline, reactor-grade hafnium were investigated by determining the effect of temperature and strain rate on the flow behavior of this metal. The above studies were carried out at temperatures ranging between 300 and 780°K. All the deformation parameters, such as activation volume and activation energy, were calculated from these measurements. Two distinct deformation mechanisms are found to exist in the temperature range investigated. The first activation event seems to be consistent with dislocations overcoming interstitial impurity atoms, while the second activation stage suggests the Peierls–Nabarro force as the controlling criterion. (auth)

3244 INTERDIFFUSION STUDIES IN ALUMINUM–NIOBIUM, ZIRCALOY-2–NIOBIUM, AND ZIRCALOY-2–TUNGSTEN SYSTEMS. Patil, R. V.; Tiwari, G. P.; Agarwala, R. P. (Bhabha Atomic Research Centre, Trombay, India). Trans. Indian Inst. Metals; 25: No. 1, 59-65(Mar 1972).

Intermetallic diffusion studies were carried out to establish the bonding characteristics of Zircaloy-2 with niobium and tungsten and of aluminum with niobium by making "sandwich"- and "plug"-type diffusion couples. X-ray and metallographic studies on diffusion couples were made with a view to establish the phase distribution in the diffusion bond. The growth kinetics of the diffusion layer were investigated by fitting the band width in the equation, $x^n = kt$, where x, n, k and t are band width, reaction index, reaction constant, and time of anneal, respectively. The studies revealed that, whereas the Zircaloy-2–tungsten system obeys the parabolic relationship with n = 2, aluminum–niobium and Zircaloy-2–niobium systems exhibit deviations from it. The temperature dependence of the diffusion reaction constant k was also established for these systems. The activation energy values for aluminum–niobium and Zircaloy-2–niobium systems were found to be 25.90 kcal/gm mol and 47.58 kcal/gm mol, respectively. The same for Zircaloy-2–tungsten was estimated to be 18.63 kcal/gm mol for α phase and 4.89 kcal/gm mol for β phase. On the basis of Kirkendall-effect porosity observed in these cases, diffusion is believed to be controlled by lattice vacancies. (auth)

3245 EFFECT OF ANNEALING TEMPERATURE ON CERTAIN PROPERTIES OF MOLYBDENUM AND TUNGSTEN FIBERS. Sebo, P.; Ivan, J.; Taborsky, L.; Havalda, A. Kovove Mater.; 10: No. 5, 423-431(1972). (In Slovak).

Properties of molybdenum and tungsten fibers for use as reinforcing elements in the fabrication of composite materials are reviewed. On the basis of a study of the strength and electrical

conductivity of these fibers, it is shown that the molybdenum fibers are suitable for the fabrication of composite materials by technologies that do not require temperatures above 600°C. The tungsten fibers are suitable for higher temperatures. It is found that the strength of the tungsten fibers varies very little up to 1100°C. Their strength is higher than that of the molybdenum fibers. From the standpoint of the strength of the tungsten fibers, diameters from 0.1 to 0.2 mm are found to be most suitable for the fabrication of composites. (IAA)

3246 MICROWAVE SURFACE IMPEDANCE STUDIES OF BERYLLIUM. Kennedy, T. A. Jr. Providence; Brown Univ. (1972). 118p. University Microfilms Order No. 73-2295.

Thesis (Ph. D.).

Three studies were made of electronic properties of single-crystal beryllium: conduction electron spin resonance (CESR), Azbel-Kaner cyclotron resonance (AKCR), and magnetic surface levels. The experiments involved measurements of the surface impedance at microwave frequencies. The CESR study was done on two samples of different purities and from different sources. Measurements of the room temperature g-values at 35 GHz with the magnetic field parallel and perpendicular to the hexad axis gave $g_{\parallel} = (2.0036 \pm 0.0001)$ and $g_{\perp} = (2.0032 \pm 0.0001)$. An angular study of effective masses in the $(10\bar{1}0)$ and (0001) planes of beryllium was made using AKCR. The samples had residual resistivity ratios of ~2000. At helium temperatures and 35 GHz, the $\omega\tau$ of a typical resonance was 10. Resonances were observed from belly and neck holes on the second-zone coronet and from electrons on the third-zone cigars. Where possible, results are compared with effective masses obtained in de Haas–van Alphen experiments. Surface impedance oscillations due to magnetic surface levels were observed at low magnetic fields. These experiments were also done at 35 GHz and helium temperatures. Most of the work was done on the $(10\bar{1}0)$ sample used in the other studies. (DLC)

3247 PHOTO-EMF ARISING IN THE p–n JUNCTIONS OF GaAs UNDER THE ACTION OF SELF-RECOMBINATIONAL RADIATION. Okunev, D. V.; Gaman, V. I. (Tomsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 138-139(1973). (In Russian).

The intensity of cathode luminescence in p and n regions of diodes and the spatial change in the photo-emf that arises in p–n junctions as a result of recombinational radiation were investigated. The recombinational radiation that was excited by an electron beam at a given depth in a crystal of GaAs was propagated in all directions, including the p–n junction. The studies showed that the distribution of photo-emf and that of luminescence intensity were similar. (KSW)

3248 THERMOLUMINESCENT INVESTIGATION OF RADIATION DEFECTS IN ALKALINE EARTH SULFATES. Ivanov, L. N.; Karelin, V. V.; Mikhailin, V. V.; Mikhaelyan, A. I. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 143-146(1973). (In Russian).

Thermoluminescence curves were drawn for alkaline earth sulfates, both unactivated and activated by Eu and Mn. Excitation of these materials was effected by the radioactive β-emitting isotopes ^{45}Ca and ^{35}S. Nonradioactive samples were excited by irradiation by a $^{90}Sr-^{90}Y$ source. The thermoluminescence peaks, occurring between 80 and 300°C are interpreted in terms of radiation capture centers. (KSW)

3249 MAGNETIC PROPERTIES OF NICKEL–SAMARIUM FILMS. Buravikhin, V. A.; Shelkovnikov, V. N.; Kameneva, G. A.; Egorov, V. A.; Manakov, N. A. (Irkutsk State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 150-151(1973). (In Russian).

The magnetic properties and the phase composition of Ni–Sm alloys were investigated up to 70% Sm, and the following phases were identified with a diffractometer: Ni, Sm, Sm_2Ni_{17}, $SmNi_5$, $SmNi_2$. The saturation magnetization of the Ni–Sm alloys was measured and compared with that of a similar range of Ni–Gd alloys. Those alloys containing Sm_2Ni_{17} possessed much greater intensity of magnetization than those containing Gd_2Ni_{17}. Samarium was less active in forming intermetallic compounds with Ni than Gd. (KSW)

3250 THERMAL OSCILLATIONS OF ATOMS OF SOME METAL HEXABORIDES. Dutchak, Ya. I.; Fedyshin, Ya. I.; Paderno, Yu. B.; Vadets, D. I. (Lvov State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 154-156(1973). (In Russian).

Several thermal properties were investigated for the following hexaborides: CaB_6, YbB_6, YB_6, LaB_6, PrB_6, NdB_6, and ThB_6. The temperature dependencies of the coefficients of thermal expansion, of the average squared lattice displacement of the metal atoms, and of the average squared lattice displacement of the B atoms were determined. (KSW)

3251 HALL COEFFICIENT OF Nd–Y ALLOYS AT 100 TO 800°K. Vereshchaka, N. P. (Odessa State Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 32-36(1973).

The concentration and temperature dependencies of the Hall coefficient were determined for the Nd–Y system at all concentrations and over the temperature interval 100 to 800°K. The results are discussed from the electronic point of view. (tr-auth)

3252 ELECTRIC QUADRUPOLE INTERACTION OF ^{181}Ta IN A Ge–Hf ALLOY MEASURED BY THE TIME-DIFFERENTIAL PERTURBED ANGULAR CORRELATION METHOD. Andreeff, A.; Hunger, H. J.; Unterricker, S. (Bergakademie, Freiberg, Ger.). Exp. Tech. Phys.; 20: No. 4, 355-364(1972). (In German).

Radioactive ^{181}Hf, produced by neutron capture, decays to ^{181}Ta. 2 at. % Hf with ^{181}Hf was dissolved in Ge at 1100°C. The measured quadrupole interation is significant for a nonaxial symmetric field gradient. Ge has a cubic lattice. For high Hf concentration, a $HfGe_2$ phase exists with rhombic lattice. It seems, that the ^{181}Ta nuclei feel the same surroundings as Hf in $HfGe_2$. This is in agreement with x-ray measurements. (auth)

3253 INFLUENCE OF ANNEALING ON MAGNETIC PROPERTIES OF $SmCo_5$. Turov, V. D.; Lobyntsev, E. S.; Malakhov, G. V.; Starkov, A. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 89-91(1973). (In Russian).

The effect of homogenizing annealing of $SmCo_5$ in a vacuum on the structure and magnetic properties of the compound was investigated. Vaporization of Sm and the manifestation of Sm_2Co_{17} phase in the structure during such annealing was accompanied by a lowering of its internal coercive force. In order to avoid this and obtain a successful annealing metallic Sm was added to the ampule of $SmCo_5$, thereby tending to saturate the vapor space with Sm and reduce Sm loss from the compound. (KSW)

3254 GRAIN GROWTH IN ALLOYED MOLYBDENUM UNDER CONDITIONS OF CREEP. Zasimchuk, E. E.; Kriveniuk, V. V. (Institut Problem Prochnosti, Kiev). Probl. Prochnosti; 4: 54-57(Aug 1972). (In Russian).

The kinetics of grain growth in two molybdenum–zirconium alloys was studied by a statistical microstructural technique as a function of the test temperature and the applied stress. It is shown that the rate of grain growth increases with increasing stress and that the temperature dependence of this rate corresponds to the temperature dependence of the rate of steady creep at the same stress level. The crystalline orientation of grains growing under conditions of creep is studied as a function of the zirconium content. (IAA)

3255 CREEP OF NICKEL AND ITS SOLID SOLUTIONS AT ELEVATED TEMPERATURES. Guseva, L. N.; Egiz, I. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 140-143(1973). (In Russian).

The influence of Al, Cr, Nb, Mo, and W on the rate of the steady-state creep of Ni was studied at the temperature equal to 0.66 of mp (825 to 890°C for the samples tested). The temperature dependence of the modulus of elasticity was measured for Ni alloys with Cr and Mo. The atom % of added metal lay within the limits of 5.8 to 6.2%. The creep data correlated well with the energies of the packing defects in these binary solid solutions. (KSW)

3256 DIELECTRIC PROPERTIES, INFRARED SPECTRA, AND ATOMIC CHARGES IN CUBIC OXIDES OF RARE EARTH METALS. Dulepov, E. V.; Batsanov, S. S.; Kustova, G. N. (Inst. of Catalysis, Novosibirsk, USSR). Zh. Strukt. Khim.; 13: No. 5, 935-938(1972). (In Russian).

The dielectric permeability, infrared absorption spectra, and dispersion of the index of refraction were studied for the rare earth oxdies: Y_2O_3, CeO_2, Pr_2O_3, Nd_2O_3, Eu_2O_3, Gd_2O_3, Tb_2O_3, Dy_2O_3, Ho_2O_3, Er_2O_3, Tm_2O_3, Yb_2O_3, and Lu_2O_3, nearly all of which had the Tl_2O_3 type of structure. Effective ion charges were compared with values calculated on the basis of the electronegativity, and fair agreement was noted. (KSW)

3257 KINETICS OF THERMAL DISSOCIATION OF TRANSITION METAL HYDRIDES. Zyryanov, G. G.; Mogutnov, B. M.; Shvartsman, L. A. (Inst. of Metal Science and Physics of Metals, Moscow). Dokl. Akad. Nauk SSSR; 208: No. 4, 888-891(1 Feb 1973). (In Russian).

The kinetics of hydride decomposition between 70 and 700°C were studied for TiH_2, ZrH_2, $NbO_{0.95}$, and $TaH_{0.8}$, by measuring the rate of H_2 release. The H_2 was carried in an Ar stream, and oxidized to H_2O that was then caught in H_2SO_4 in a microcalorimeter where the rate of heat release was measured. Possible mechanisms are discussed, based upon the relative decomposition rates of the hydrides in various regions of the temperature range. Decomposition rates were also studied as a function of the coarseness of the particle size of the hydride. (KSW)

3258 DEPENDENCE OF YIELD POINT ON GRAIN SIZE AND COMPARISON BETWEEN MONOCRYSTALS AND POLYCRYSTALS IN HEXAGONAL METALS, PARTICULARLY IN CADMIUM. Maennel, P.; Hoetzsch, G.; Guenther, F. Neue Huette; 17: No. 12, 710-715(Dec 1972). (In German).

Knowledge of the texture was a basic prerequisite for determining which findings on single-crystal plasticity could be used to explain the deformation behavior of polycrystals. For all studied textures, the grain size dependency of $\sigma_{0.2}$ followed at 77°K the Petch relation. The factors σ_0 and k of this relation assumed a different significance in accordance with the occurrence of creeping and/or twinning. For several investigated textures, the mean orientation factors were given as determined by a previously described method. The calculated values described satisfactorily differences between the experimental Petch stresses and the literature data for creeping stresses in single crystals. Some graphical data for cadmium are presented. (5 figures, 28 references) (tr-auth)

3259 DEPENDENCE OF DUCTILITY OF RECRYSTALLIZED MOLYBDENUM ON OXYGEN CONCENTRATION AND GRAIN SIZE. Zelenskii, G. K.; Borodich, V. D.; Korontsevich, V. K. Izv. Akad. Nauk SSSR, Metal.; No. 1, 151-155(1973). (In Russian).

The influence of the oxygen content (0.001 to 0.004 wt.%) and grain size (40 to 180 μ) on the structure and ductile properties of Mo was studied. Its ductility increased with purity and decreased with increased grain size. The change in ductility of Mo and the quantity separated at the grain boundaries were in qualitative agreement with the specific concentrations of the impurities at the grain boundaries. (KSW)

3260 INFLUENCE OF CARBON ON FINE STRUCTURE OF CAST MOLYBDENUM. Ageev, N. V.; Ignatov, D. V.; Kantor, M. M.; Makunin, M. S.; Naletov, A. M. Izv. Akad. Nauk SSSR, Metal.; No. 1, 168-173(1973). (In Russian).

The effects of a varying C content (from 0.01 to 0.05 wt.%) in cast Mo–C alloys on the fine structure and C distribution were studied. For given melting and cooling conditions at which solidification occurred, decomposition of the weakly supersaturated (by carbon) solid solution took place predominantly with heterogeneous production of carbide separation at the dislocations and surfaces of separation between Mo–Mo_2C phases. (KSW)

3261 CRYSTALLOGRAPHIC STRUCTURE OF LOW-TEMPERATURE URANIUM OXIDES IN THE COMPOSITION RANGE FROM UO_2 TO U_3O_8. Wozniakowski, B. (Inst. of Low Temperatures and Structural Research, Wroclaw). Wiad. Chem.; 26: 543-554(1972). (In Polish).

The phase diagram of the UO_2–U_3O_8 system was complied from a review of the literature. Phase relations are discussed from the point of view of the crystallographic relationship of structures. (auth)

3262 DETERMINATION BY X-RAY DIFFRACTION OF PHASES PRESENT IN TUNGSTEN COMPOUNDS. Rautschke, R.; Dowe, C. (Martin Luther Univ., Halle, Ger.). Z. Chem.; 12: No. 8, 303-304(1972). (In German).

The compositions of powder mixtures of WO_3, WO_2, WC, W_2C, and tungsten were determined by x-ray diffraction with an error of 2.8% (25 measurements) by first investigating known mixtures of the components in pairs. Intensity ratios were measured at known d values (Cu Kα) for the compounds, and a series of constants was evaluated, these constants then being used in examining unknown mixtures. (Anal. Abstr.)

3263 ELECTRON-DIFFRACTION STUDY OF MELTING PROCESS OF INDIUM FILMS. Buntar, A. G.; Krupelnitskii, V. A.; Tkhorivskii, A. M. Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 10, 1720-1725(Oct 1972). (In Russian).

The melting process of polycrystalline indium films was investigated by the kinematic electron-diffraction method. It is shown that the melting process was not accompanied by a step change in the electron scattering character. Important structural changes in thin indium films take place both before and after melting within a temperature range of 10°. (tr-auth)

3264 CONSTITUTION AND STRUCTURE OF PLATINUM–INDIUM ALLOYS. Jain, K. C.; Bhan, S. (Banaras Hindu Univ., India). Trans. Indian Inst. Metals; 25: No. 3, 100-102(Sep 1972).

The phase diagram of the system platinum–indium was worked out by means of thermal analysis, metallographic methods, and x-ray-diffraction techniques. The investigation established the existence of eight intermediate phases, Pt_3In, Pt_2In, $Pt_3In_2(h)$, $Pt_3In_2(r)$, $Pt_{13}In_9$, Pt_2In_3, $PtIn_2$, and Pt_3In_7. The crystal structures of these phases are discussed. (auth)

3265 DETERMINATION OF THERMODYNAMIC ACTIVITIES IN SYSTEM Cd–In BY CALORIMETRIC MEASUREMENTS. Rosina, A. (Div. of Mining and Metallurgy, Ljubljana, Yugoslavia). Mining Met. Quart. (Engl. Transl.); No. 2-3, 85-105(1971).

Translated from Rudarsko-Met. Zbornik; No. 2-3, 217-237(1971).

The known binary phase diagram of Cd–In and thermodynamic properties of constituents of this system, determined by vapor pressure measurements, were checked by "classical" calorimetry after Oelsen. The result and thermodynamic analysis of the Cd–In system showed that simple research methods can give basic thermodynamic quantities. The experimental results and the evaluated thermodynamic properties confirm some characteristic temperatures of this phase diagram previously given in only one reference, and made it possible to determine the formation potentials $P_{x,T}$ over the whole concentration range. Evaluated thermodynamic activities of both constituents show a positive deviation from ideal and confirm the known values. (auth)

3266 INFLUENCE OF HAFNIUM DIOXIDE ON GRAIN GROWTH AND TOUGHNESS OF NIOBIUM. Samsonov, G. V.; Kushtalova, I. P. Izv. Akad. Nauk SSSR, Metal.; No. 1, 177-180 (1973). (In Russian).

The effects of HfO_2 particles on grain growth of a Nb matrix and the behavior of the HfO_2 particles during isothermal annealing were investigated. The greatest yield limits characterized the alloy Nb–7 vol % HfO_2, although alloys with 0, 3, 7, and 10% HfO_2 were tested and compared. Flexing tests with the latter gave values of 50, 53, 57, and 51 kg/mm^2, respectively. HfO_2 contents in excess of 10% caused embrittlement. (tr-auth)

3267 LAVES PHASES IN HAFNIUM ALLOYS WITH GROUP IV TRANSITION METALS. Kocherzhinskii, Yu. A.; Markiv, V. Ya.; Pet'kov, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 1, 189-195(1973). (In Russian).

Hafnium formed from one to three Laves phases with the majority of the transition metals of Group IV, and the extent and composition of the Laves phase depended on the nature of the added metal. Phase composition diagrams were constructed for the Hf–Me systems, where Me = V, Cr, Mn, Fe, Co, and Ni. The following phases were identified: Hf–V, λ_2; Hf–Cr, λ_1, λ_2, and λ_3; Hf–Mn, λ_1; Hf–Fe, λ_1, λ_2, and λ_3; Hf–Co, λ_2; Hf–Ni, λ_2. (KSW)

3268 CRYSTAL–CHEMICAL ANALOGY BETWEEN EUROPIUM, YTTERBIUM, CALCIUM, AND BARIUM IN THEIR ALLOYS WITH MANGANESE. Frankevich, D. P.; Zarechnyuk, O. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 196-198(1973). (In Russian).

The systems Me–Mn were synthesized and compared by x-ray phase analysis. The absence of compounds and the identical character of the x-ray peaks, with limited solid-solution formation in the Eu and Yb systems with Mn, and the alkaline earth systems Ca and Ba with Mn, all indicated that Eu and Yb behave in their alloys with Mn like divalent metals, and as electronic analogs of Ba and Ca, and are indeed crystallochemical analogs of the latter. (KSW)

3269 PHASE-COMPOSITION DIAGRAMS OF W–Ta–Re BY METHOD OF DIFFUSED LAYERS. Tregubov, I. A.; Evseeva, L. N.; Ivanov, O. S.; Marchukova, I. D. Izv. Akad. Nauk SSSR, Metal.; No. 1, 198-204(1973). (In Russian).

The ternary phase diagram at 1500°C was constructed for the system W–Ta–Re by local x-ray spectral analysis of the diffused layers. The formation of the three binary systems was similarly studied. The coefficients of mutual diffusion of W and Ta were measured at 1500°C, and their dependence on the W concentration was ascertained from 10 to 50% W. (KSW)

3270 PHASE STATE OF Nb–1% Zr–C AND Nb–2% Hf–C ALLOYS. Grigorovich, V. K.; Sheftel, E. N.; Trankovskaya, G. R. Izv. Akad. Nauk SSSR, Metal.; No. 1, 205-211(1973). (In Russian).

A second phase, predominantly Nb_2C, was detected in the alloys Nb–1% Zr–C and Nb–2% Hf–C. The Nb carbides formed irrespective of the form or the abundance of the carbon alloy. Microstructure, alloy hardness, electron-microdiffraction patterns, and lattice studies contributed to this information. (KSW)

3271 COMPOSITION OF THE Ni–NiMo EUTECTIC BY ZONAL RECRYSTALLIZATION. Kurilo, Yu. P.; Somov, A. I.; Tortika, A. S. Izv. Akad. Nauk SSSR, Metal.; No. 1, 216-217 (1973). (In Russian).

The composition Ni–35.8% at .% Mo was shown to be very close to the eutectic point of the Ni–NiMo system, using the method of zonal recrystallization of the alloys. The microstructures of Ni–Mo alloys containing 68.8, 65, and 63% Ni, as well as Ni–Mo eutectic were photographed and discussed. (KSW)

3272 RELATIONSHIP OF THERMODYNAMIC PROPERTIES OF LIQUID ALLOYS BASED ON ALUMINIUM TO GEOMETRY OF PHASE COMPOSITION DIAGRAM. Batalin, G. I.; Beloborodova,

E. A. Izv. Akad. Nauk SSSR, Metal.; No. 1, 218-222(1973). (In Russian).

A correlation was observed between the thermodynamic characteristics of certain liquid Al alloys and their phase composition diagrams. For stratifying systems, the intensity of reaction between different kinds of atoms was observed to take the following order: Tl–Al → Pb–Al → Bi–Al → In–Al → Cd–Al → Ga–Al. For the eutectic systems, the intensification of reaction between different kinds of atoms assumed the order: Sn–Al → Zn–Al → Si–Al → Ge–Al. For systems with chemical compounds, the intensity of interaction between atoms the following sequence was found: Ag–Al → Mg–Al → Cu–Al → Mn–Al → Fe–Al → Co–Al → Ni–Al → Au–Al. (26 references) (tr-auth)

3273 PLASTIC DEFORMATION OF AN YTTRIUM ALLOY. Solenov, V. M.; Skudnov, V. A.; Sokolov, L. D.; Gladkikh, A. N. Izv. Akad. Nauk Arm. SSR, Ser. Tekh. Nauk; 25: No. 2, 28-33 (1972). (In Russian).

Investigation of the plasticity of rod-shaped specimens of an 97.388% yttrium alloy after mechanical and thermal treatment and pressing. Temperature dependence curves are plotted for stresses vs strains in specimens subjected to punching at different temperatures and different die application rates. (IAA)

3274 INCORPORATION OF SLIP DISLOCATIONS IN (1102) TWINS IN ZIRCONIUM. Dickson, J. I.; Robin, C. (Ecole Polytechnique, Montreal). Mater. Sci. Eng.; 11: 299-302(1973).

Results of a study of $\{1\bar{1}02\}$ twin growth in 99.9% pure Zr having 100 to 400 (wt.) ppm of oxygen as major interstitial impurity are described. The results provide evidence to support the theory that the growth of $\{1\bar{1}02\}$ twins in hcp metals can result from the incorporation of slip dislocations. In particular, the study results indicate that the growth of a $(1\bar{1}02)$ twin in zirconium usually results from either two $\frac{1}{3}[21\bar{1}\bar{0}]$ dislocations on a $(01\bar{1}0)$ plane or two $\frac{1}{3}[1\bar{2}10]$ dislocations on a $(\bar{1}010)$ plane being incorporated into the twin and producing a zonal twinning dislocation at the interface and either a $\frac{1}{3}[11\bar{2}\bar{3}]^*$ or a $\frac{1}{3}[\bar{1}1\bar{2}3]^*$ dislocation in the twin. The $\frac{1}{3}\langle 11\bar{2}3\rangle^*$ dislocation usually dissociates near the twin interface to give a $\frac{1}{3}\langle 11\bar{2}0\rangle^*$ dislocation and a $\langle 0001\rangle^*$ dislocation. (auth)

3275 LEGIROVANIYE I SVOYSTVA ZHAROPROCHNYKH SPLAVOV. (Alloying and Properties of High-Temperature Alloys). Ageev, N. V.; Savitskii, E. M.; Kornilov, I. I.; Zudin, I. F.; Prokof'ev, D. I. Moscow; Izdatel'stvo Nauka (1971). 208p.

The collection covers topical problems of the theory of heat resistance (mechanism of creep, hardening of solid solutions by alloying to produce stable dislocation structures, precipitation hardening, and the effect of the type, quantity, and pattern of excess phase distribution on the creep and failure of alloys). Some of the papers discuss problems related to the interaction of metallic materials with the environment (problems of protective coatings on high-temperature alloys, diffusion processes within these alloys). The collection is intended for researchers, design engineers, production personnel, metallurgists, and associates of establishments in power engineering and transportation machinery as well as in the aviation industry. (JPRS)

3276 PRECIPITATION IN ELECTRON-BEAM WELDED BERYLLIUM INGOT SHEET. Fraikor, F. J. (Metro State Coll., Denver); Hicken, G. K.; Grotsky, V. K. AT(29-1)1106. Weld. J. (N. Y.); 52: No. 5, 204s-211s(May 1973).

An investigation was conducted to observe the types, morphology, and behavior of impurity precipitates in beryllium ingot sheet that had been welded by an electron-beam technique. Optical and electron metallography revealed a clear structural transition between the various weld zones. Transmission electron microscopy of the unaffected zone showed dislocation sub-boundaries 1 to 10 microns in diameter with $AlFeBe_4$ precipitates both in the matrix and sub-boundaries. In areas where the localized weld heating produced temperatures in excess of 900°C followed by moderate cooling, aluminum-rich grain boundary precipitates were found. Electron-microprobe scanning of weld cracks revealed that these aluminum-rich precipitates introduce hot-short liquid areas which, combined with thermal stresses, produce intergranular cracks. Transmission photomicrographs further showed that the solidification bands consisted of rows of both irregular shaped $AlFeBe_4$ precipitates and platelets of $FeBe_{11}$ interconnected by dislocation sub-boundaries. It is postulated that these solidification bands are produced by solidification fluctuations with resultant microsegregation of iron and aluminum. (auth)

3277 EFFECT OF THIRD METAL ON THE MAGNETIC AND STORAGE PROPERTIES OF ELECTRODEPOSITED PERMALLOY FILMS. Venkatasetty, H. V. (Honeywell Corporate Research Center, Bloomington, MN). J. Electrochem. Soc.; 120: No. 5, 618-621(May 1973).

Controlled quantities of reducible metal ions like molybdenum and indium are introduced in the appropriate form into a nickel–iron bath and the magnetic properties of the ternary alloy films of Ni–Fe–Mo and Ni–Fe–In are measured over a wide range of concentration of molybdenum and indium in the bath. These films show much improved magnetic properties as well as some improvement in creep-resistant characteristics when compared with permalloy films. The improved properties of these films are discussed in terms of the improved magnetic parameters and thickness. (34 references) (auth)

3278 EXPLORATORY STUDY OF A FLUXLESS ALUMINUM BRAZING PROCESS FOR BERYLLIUM. Juntz, R. J.; King, W. G.; Tardiff, G. Jr.; Westlund, E. F. (Univ. of California, Livermore). Weld. J. (N. Y.); 52: No. 4, 187s-192s(Apr 1973).

A process for fluxless vacuum brazing of beryllium with aluminum that involves preplacing the aluminum and applying a small pressure (<1 psi) across the joint during brazing was found to result in very high joint tensile strengths. The peak strengths of nominal 0.0005-in. thick brazes made with nominal 99.999% Al, 1100 Al, and an Al–12% Si alloy below 725°C were found to be within a few thousand psi of the Be base metal yield strengths (33,000 and 40,000 psi). Variability in the joint strengths, however, would limit design stress to about 20,000 psi. Differences in the degree of alloying across the Be and Al interfaces and in the final joint thicknesses are cited as contributing to the strength variation. The former is affected by variation in oxide film thickness and in the manner in which the Al oxide film breaks up during the pressure brazing process. Some of the data and a qualitative argument suggest that an optimum braze thickness for maximum strength may exist under conditions of base metal yielding. The iron impurity in the 1100 Al brazing material results in a high density of iron-rich particles near the interface in the case of thick (>0.010 in.) brazes that could degrade the strength of thick brazes. Suggestions for improving the consistency of the process to give higher useful design stress is given. (auth)

3279 LOCALIZED HYDROGEN IN TITANIUM WELDS. Adler, P. N. (Grumman Aerospace Corp., Bethpage, NY); Kennedy, J.; Satkiewicz, F. G. Weld. J. (N. Y.); 52: No. 4, 180s-186s(Apr 1973).

Ion microprobe analysis was utilized to investigate the role of hydrogen in the formation of massive voids during electron beam welding of titanium and to evaluate hydrogen contamination and its removal associated with vacuum and air annealing. Localized measurements of hydrogen concentration were made on hydrogen-charged and -annealed surfaces as well as on simulated void specimens that were prepared by hydrogen charging and welding. Hydrogen enrichment was observed near massive voids, which indicates that hydrogen does play a significant role in the formation of voids in hydrogen-charged specimens. Vacuum annealing was most effective in reducing the hydrogen concentration, whereas air annealing caused significant increases. (auth)

3280 CRACK PROPAGATION BEHAVIOR IN TYPE 304 STAINLESS STEEL WELDMENTS AT ELEVATED TEMPERATURE. James, L. A. (Westinghouse Hanford Co., Richland, WA). Weld. J. (N. Y.); 52: No. 4, 173s-179s(Apr 1973).

The fatigue-crack propagation behavior of weldments in Type-304 stainless steel at 1000°F (538°C) was studied using the techniques of linear-elastic fracture mechanics. Three different welding processes were evaluated: gas-tungsten-arc welding (GTAW), submerged-arc welding (SAW), and shielded-metal-arc welding (SMAW). In addition, a variety of crack orientations with respect to the weld were studied. For a given crack orientation, no difference was noted in the behavior between the three welding processes. It was also found that, in every welded specimen tested, the crack growth rate was within, or below the scatter band for base metal specimens tested under similar conditions. Therefore, it appears that test results obtained on base metal specimens may be conservatively used to evaluate the structural performance of welded components. (auth)

3281 MECHANICAL PROPERTIES OF WELD, BASE METAL, AND COATED COLUMBIUM ALLOY Cb 752. Tavassoli, A. A. (Marshall Space Flight Center, Huntsville, AL). Weld. J. (N. Y.); 52: No. 4, 168s-172s(Apr 1973).

Bend ductility and elevated temperature tensile properties of sheet Cb-752 have been evaluated. Bend tests were conducted from 260 to −184°C (500 to −300°F) and tensile tests up to 1427°C (2600°F). Gas tungsten-arc welding (GTAW) or electron beam welding (EBW) had no significant effect on tensile strength of sheet Cb-752, but markedly reduced ductility. Postweld annealing had no improving effect on elongation and only lowered ductile-to-brittle transition temperature of EB weld material. R512E coating (Si–20Cr–20Fe) on both welded and base metal Cb-752 sheet had a uniform thickness and resulted in an equal substrate consumption. However, R512E further decreased tensile elonga-

tion of welded Cb-752. In view of the marked reductions in ductility of Cb-752 after welding and coating, detailed evaluation of welded columbium-alloy panels for the thermal protection system of the space shuttle and the aerobraking system of the space tug is necessary. (auth)

Radiation Effects

Refer also to abstracts 3017, 3033, 3034, 3036–3044, and 4462.

3282 (COO-3171-13) ELECTROMIGRATION STUDY OF VOID KINETICS IN METALS. Annual Progress Report. Ho, P. S. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). Mar 1973. Contract AT(11-1)-3171. 11p. Dep. NTIS $3.00.

Progress is reported on: electron microscopy studies of defect clusters in electron-irradiated aluminum films; growth kinetics and orientation dependence of dislocation loops in electron-irradiated aluminum; and observation of damage in helium-ion-irradiated gold films. (auth)

3283 (JEN-242) PRODUCTION OF HYDROGEN AND HELIUM ATOMS IN NUCLEAR REACTOR MATERIALS OF CONSTRUCTION; BRITTLENESS OF AUSTENITIC STEELS AT HIGH TEMPERATURES. Jimenez, J. L. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 49p. (In Spanish). Dep. NTIS (U. S. Sales Only) $4.50.

The production of atoms of hydrogen and helium in reactor materials by (n,p) and (n,α) reactions, particularly in stainless steel fast reactor fuel-cladding materials, modifies the ductility and rupture life. A method (PROTALFA Fortran IV program) is presented for the calculation of the quantities of hydrogen and helium generated in an alloy, irradiated under specified spectrum and flux conditions. Clad materials such as 304 and 316 SS, niobium, vanadium–titanium, and Zircaloy were studied under conditions existing in the Thermal Power Reactor (Zorita) and a hypothetical fast reactor of a flux at 10^{16} n/cm^{-2} s^{-1} and soft, intermediate, and fission spectrum. The effects of the spectrum form in the fast reactor and the elimination of ^{10}B in Zorita were observed. (auth)

3284 (N-73-12550) IRRADIATION EFFECTS ON 17-7 PH STAINLESS STEEL, A-201 CARBON STEEL, AND Ti–6% Al–4% V ALLOY. Hasse, R. A.; Hartley, C. B. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov 1972. 19p. (NASA-TM-X-2678). NTIS.

Irradiation effects on three materials from the NASA Plum Brook Reactor Surveillance Program were determined. An increase of 105 K in the nil-ductility temperature for A-201 steel was observed at a fluence of approximately 3.1×10^{18} neutrons/sq cm (neutron energy $E_n > 1.0$ MeV). Only minor changes in the mechanical properties of 17-7 PH stainless steel were observed up to a fluence of 2×10^{21} neutrons/sq cm ($E_n > 1.0$ MeV). The Ti–6% Al–4% V alloy maintained its notch toughness up to a fluence of 1×10^{21} neutrons/sq cm ($E_n > 1.0$ MeV). (auth)

3285 (ORNL-TM-4156, pp 1-16) IRRADIATION EXPERIMENTS. Wiffen, F. W. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

Results are presented from an experiment whereby α particles were injected via an ORIC beam into CTR materials Nb, Nb–1Zr, Mo, TZM, V–20% Ti, and Vanstar-7 to simulate effects of helium produced by n,α transmutations. Also, some comparison is made between irradiation of some of these materials in the HFIR and the EBR-II; the experiments are discussed briefly. (MOW)

3286 (ORNL-TM-4156, pp 27-48) MECHANICAL PROPERTIES OF IRRADIATED MOLYBDENUM. Wiffen, F. W. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

Some changes produced in the mechanical and physical properties of Mo and Mo–0.5% Ti by neutron irradiation in EBR-II were determined. These experiments generally involved irradiation at reactor ambient temperatures (100°C or lower) and fast fluences of 10^{20} neutrons/cm^2 or lower. Properties were measured in the as-irradiated state and following post-irradiation annealing. Tensile strength measurements are described. (MOW)

3287 (ORNL-TM-4156, pp 48-62) STUDIES OF SWELLING IN REACTOR-IRRADIATED METALS. Wiffen, F. W. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

Results were obtained on specimens that had been fully recrystallized prior to irradiation. The annealing treatments were appropriate for each of the materials V, Nb, Mo, Ta, Mo–0.5 Ti, Nb–1 Zr, and V–20 Ti. The irradiations were performed in the EBR-II reactor. Swelling and void parameter data are given. (MOW)

3288 (ORNL-TM-4156, pp 63-67) DAMAGE SIMULATION STUDIES. Stiegler, J. O. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

Neutron irradiation in conventional fission reactor test facilities cannot completely simulate the damage in a fusion reactor because of large differences in the neutron spectra. The use of a 6-MeV Van de Graaff accelerator and heavy ion beams to simulate high-energy neutron damage is discussed. Problems relating to the simulation process are described. (MOW)

3289 (ORNL-TM-4156, pp 68-71) ORR-227: TEMPERATURE-DEPENDENT NEUTRON-DAMAGE STUDY. Davis, W. W. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

An experiment to irradiate in ORR, specimens of Al, Ni, V, and alloys of Mo and Nb at controlled temperatures from 200 to 900°C, is described. Low temperature conditions (200 to 250°C) were not achieved at full reactor power. (MOW)

3290 (ORNL-TM-4156, pp 71-80) ION BOMBARDMENT CHAMBER. Wolfenden, A. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

The ion bombardment chamber and specimen assembly are described. Ion beams from the Van de Graaff enter the system through a valve assembly at the top. Their energies are reduced by metal foils in the rotatable degrader wheel. Some typical data are described. (MOW)

3291 (ORNL-TM-4156, pp 80-85) SOME EFFECTS OF NEUTRONICALLY GENERATED GASES IN METALS. Farrell, K. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

An Al alloy with about 2300 at. ppM ^{6}Li in the form of an annealed rod about 2-in. long by 0.12-in. diameter was irradiated in the strong thermal neutron environment of the HFIR. The dislocations and cavities in the specimen are shown. Grain-boundary fracture surfaces are also discussed. (MOW)

3292 (TIM-813) PROGRAM TO STUDY THE EFFECTS OF NEUTRON IRRADIATION UPON NIOBIUM BASE ALLOYS. Carlson, C. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 12 Mar 1964. 14p. Dep. NTIS.

Declassified 20 Oct 1971.

Plans for irradiation testing of Nb–1 Zr alloy and Nb–1 Zr–0.1 C alloy are presented. The materials to be tested are described along with experimental conditions and flow charts which show radiation exposure regimes. (JRD)

3293 (TIM-813(Suppl. 1)(Rev. 1)) PROGRAM TO STUDY THE EFFECTS OF NEUTRON IRRADIATION UPON NIOBIUM-BASE ALLOYS. Carlson, C. E. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 17 Jun 1964. 4p. Dep. NTIS.

Plans for subjecting Nb–1Zr and Nb–1Zr–0.1C alloys to tensile testing and microexamination in the irradiated and unirradiated condition are summarized. Materials preparations are described along with experimental test conditions. Flow charts are included giving conditions and time schedules for the tests. (JRD)

3294 (WAPD-TM-1027) IRRADIATION CREEP BASED ON DISLOCATION CLIMB (LWBR DEVELOPMENT PROGRAM). Dollins, C. C. (Bettis Atomic Power Lab., Pittsburgh, PA). Feb 1973. Contract AT(11-1)-Gen-14. 44p. Dep. NTIS $4.25.

It is believed that creep in materials containing a dispersed second phase may be controlled by the climb of edge dislocations around the second phase. The applicability of this model to neutron-irradiated materials containing Seeger zones is proposed. It is assumed that edge dislocations are pinned by the zones and can escape by (1) climbing out of the zones by absorption of neutron-produced point defects, (2) dissolution of the zones by absorption of neutron-produced interstitials, (3) dissolution of the zones by vacancy emission from the zones, and (4) thermally activated cutting of the zones by the dislocations. These four mechanisms are incorporated into a set of equations similar to those originally proposed by Seeger for hardening in neutron-irradiated copper. The effects of temperature, neutron flux, fluence, and applied stress are considered. (13 figures, 28 references) (auth)

3295 (WAPD-TM-1066) VISCOELASTIC ANALYSIS OF IN-PILE STRESS RELAXATION (LWBR DEVELOPMENT PROGRAM). Wolfe, R. A.; Hyatt, B. Z. (Bettis Atomic Power Lab., Pittsburgh, PA). Mar 1973. Contract AT(11-1)-Gen-14. 16p. Dep. NTIS $3.00.

A description of in-pile stress relaxation on the basis of a Maxwell–Kelvin linear viscoelastic model is developed from the assumption of a mechanical equation of state combined with creep characteristics observed in in-pile creep experiments. A previous proposal that in-pile stress relaxation can be represented by this viscoelastic model is further substantiated by an analysis of in-pile stress relaxation data for Almar 362, a maraging stainless steel. The data show general agreement with the type of stress relaxation curves predicted by the model. In addition, consideration of the effect of strains introduced in the specimens prior to the in-pile relaxation helps to resolve an apparent discrepancy in the temperature dependence of different sets of Almar relaxation data. This work is part of the LWBR development program. (auth)

3296 MAGNETIZATION MEASUREMENTS ON FAST-NEUTRON IRRADIATED NIOBIUM AND TECHNETIUM. Brown, B. S.; Blewitt, T. H.; Scott, T. (Argonne National Lab., IL) Phys. Status Solidi (a); 16: No. 1, 105-113(6 Mar 1973).

High-purity crystals of niobium and technetium were irradiated with fast neutrons at 5°K up to fluences of 1×10^{18} n/cm^2. Direct-current magnetization measurements obtained without warmup show an increase in magnetic remnance and H_{c_2} with neutron dose. Single-crystal technetium was investigated for different crystal orientations. The effect of impurities and annealing was investigated in niobium. The magnetization curves clearly indicate that low temperature irradiation leads to a larger decrease in the electronic mean free path and considerably weaker pinning of the magnetic fluxoids than irradiation at 40°C. The behavior of magnetic remnance with dose is similar to yield stress measurements of fast-neutron irradiated niobium.(7 figures, 20 references) (auth)

3297 SHAPES OF IRRADIATION-PRODUCED VOIDS IN NICKEL. Chen, C. W. (Ames Lab., Iowa). Phys. Status Solidi (a); 16: No. 1, 197-210(16 Mar 1973).

Voids were produced in nickel by protons and Ni^{2+} ions at 500°C. Methods for an accurate determination and quantitative description of the shape of voids are discussed. The voids thus produced in Ni are prominently cubo-octahedral with 100% truncation, or octahedral with partial {100} truncation, and occasionally cubic with partial {111} truncation. The present results, coupled with previous observations, thus assert a ready change in shape of the voids. Reasons for the wide shape change are explained in terms of the anisotropy of surface energy, the kinetics of growth of void surfaces, and a preferential adsorption of carbon atoms on the {100}-surfaces of voids during irradiation. (4 figures, 2 tables, 37 references) (auth)

3298 HIGH-VOLTAGE ELECTRON-MICROSCOPE STUDIES OF VOID NUCLEATION IN NICKEL. Harbottle, J. E.; Norris, D. I. R. (Central Electricity Generating Board, Berkeley, Eng.). J. Microscopy; 97: No. 1-2, 129-138(Jan 1973).

The influence of dislocation behaviour on void formation in the high voltage electron microscope (HVEM) was predicted theoretically and confirmed by experiment. The probability of void nucleation was computed as a function of the radial distance from a dislocation line in a finite cylinder of material. The observation of strings of voids associated with dislocation lines supports the predictions of the model. Void formation in the HVEM is closely related to the detailed microstructural changes that occur immediately upon electron irradiation, and a good correlation is obtained between the initial interstitial loop density and subsequent swelling by electrons. A minimum foil thickness is neeessary for void growth in the HVEM; otherwise the surfaces dominate and the dislocation density always remains low. (auth)

3299 APPLICATION OF HIGH-VOLTAGE ELECTRON MICROSCOPY TO LOW-TEMPERATURE RADIATION-DAMAGE STUDIES IN METALS. Urban, K. (Max-Planck-Institut fuer Metallforschung, Stuttgart). J. Microscopy; 97: No. 1-2, 121-127(Jan 1973).

The advantages of high-voltage electron microscopy applied to low-temperature radiation damage studies are briefly reviewed. Such studies may be performed inside the microscope provided a high-resolution specimen cooling stage is available. The main features of a new type of cooling stage used in the experiments are outlined. The applicability of the stage for post-irradiation annealing experiments is emphasized. During electron irradiation to high doses at 8°K, formation of defect clusters was observed in nickel and copper. This is accompanied by pronounced changes in the diffraction pattern. Post-irradiation annealing of samples irradiated at 8°K produces defect clusters that can be identified as dislocation loops. (auth)

3300 GEOMETRY OF DISLOCATION LOOPS GENERATED IN α-IRON BY 1-MeV ELECTRON IRRADIATION AT 550°C. Little, E. A.; Eyre, B. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Microscopy; 97: No. 1-2, 107-111 (Jan 1973).

Rectilinear dislocation loops are observed to grow in thin foils of α-iron during 1-MeV electron irradiation at 550°C in the beam of a high-voltage electron microscope. A diffraction analysis indicates that the loops have sides parallel to ⟨100⟩ directions and are pure edge with a ⟨100⟩ Burgers vector. Only interstitial-type loops have been identified. The geometry of the loops can be accounted for by an established model of loop nucleation. (auth)

3301 DISLOCATION PINNING IN Mo AND Cu AFTER NEUTRON IRRADIATION AT LOW TEMPERATURE. Okuda, S.; Mizubayashi, H. (Japan Atomic Energy Research Inst., Tokai). Phys. Status Solidi (a); 16: No. 2, 355-364(16 Apr 1973).

The internal friction and dynamic modulus of Mo polycrystals were measured after fast-neutron irradiation at liquid helium temperature. Similar measurements were also made on a Mo single crystal and Cu polycrystals for comparison purpose. It is found that the dislocation pinning in Mo started at about 30°K. This pinning process proceeded up to 80°K. During annealing above 80°K, the modulus change along with the change in the α-peak was observed. The apparent difference between Mo and Cu in the pinning process is a continuous decrease in the thermal component of dislocation motion over a wider range of temperature in Mo. (11 figures) (auth)

3302 INFLUENCE OF A NEUTRON IRRADIATION ON THE RECRYSTALLIZATION BEHAVIOR OF ROLLED COPPER MONOCRYSTALS. Holzer, H. P. Stuttgart; Stuttgart Univ. (1972). 104p. Library, Stuttgart Univ. (In German).

Thesis (Ph.D.).

Copper monocrystals with a (110) rolling plane and a [112] rolling direction 86.5 to 98.5% were reversibly rolled and finally underwent recovery and recrystallization annealing. The inner parameter, the defect density, is then varied. It was possible to follow the recovery behavior by means of microhardness measurements and electron microscopic pictures of the dislocation structure. The stored energy was measured with a microcalorimeter and the dependence of the grain boundary rates on the annealing time was determined. The influence of additional lattice defects due to irradiation with fast neutrons was examined. The irradiated samples were recrystallized by a laser flash and the distribution curves of the cutting chord were determined. The relationship between the rate of nucleation and the previous neutron irradiation is given. The orientation distribution of the crystallite in such samples was determined with a (111) plane polarization model. The orientation of a single fast growing crystallite can be determined using Laue pictures. The orientation data of a grain boundary is given by an electron microscope and the ordering of the atoms in the "boundary step." (GF)

3303 MONTE CARLO SIMULATION OF THE OMEGA-PHASE TRANSFORMATION. De Fontaine, D.; Buck, O. (Univ. of California, Los Angeles). Phil. Mag.; 27: No. 4, 967-983 (Apr 1973).

A model of the β-to-ω phase transformation in Ti, Zr, and Hf alloys is proposed whereby the three-dimensional displacive transition is decomposed into one-dimensional and two-dimensional components. The one-dimensional component is postulated to be a linear displacive defect along (111) close-packed rows of the bcc structure, and the two-dimensional component then consists of the cooperative ordering of neighboring parallel linear defects in the (111) planes normal to the linear component. That the two-dimensional cooperative ordering of displaced row segments can lead to a sharp phase transition is demonstrated by a two-dimensional Monte Carlo simulation involving three types of symbols with nearest-neighbor interactions. Computer simulation exhibits characteristic two-domain ω structures which, along with the linear defect structure, appear to explain, at least qualitatively, observed electron and neutron diffraction patterns. It is tentatively suggested that the postulated linear defects play an important role in internal friction and in anomalous diffusion in certain bcc metals. (auth)

3304 COMPUTER SIMULATION IN RADIATION DAMAGE STUDIES. Torrens, I. M. (Centre d'Etudes Nucleaires, Saclay, France). Comput. Phys. Commun.; 5: No. 1, 32-43(Jan 1973).

The application of atomistic computer simulation to problems involving radiation damage and lattice defects in crystalline solids is discussed. The different topics include static defect configurational simulations, molecular dynamics of thermal motion, low-energy atomic collision events, high-energy atomic

displacement cascades, and the thermal annealing of concentrations of defects in a region of lattice. The methods described are evaluated from the point of view of the assumed physical models, and their capabilities and limitations are indicated. Emphasis is on techniques used rather than on results obtained. (auth)

3305 MEASUREMENT OF THIRD-ORDER ELASTIC CONSTANTS OF SINGLE CRYSTAL NICKEL AT 298°K. Sarma, V. P: N.; Reddy, P. J. (Sri Venkateswara Univ., Tirupati, India). Phil. Mag.; 27: No. 4, 769-775(Apr 1973).

The complete set of third-order elastic constants of neutron-irradiated single-crystal nickel at 298°K were determined from the changes in the natural sound velocities under uni-axial compression. The experimental method was the pulse interference technique at 10 MHz, and was capable of measuring changes in velocity to a few parts in 10^6. The specimen was placed in a transverse saturation magnetic field in order to eliminate the pressure-dependent magnetoelastic effects and the ultrasonic attenuation due to the presence of magnetic domains. The measured values in units of 10^{12} dyn/cm^2 are: $C_{111} = -21.04 \pm 1.24$; $C_{112} = -13.45 \pm 0.84$; $C_{123} = +0.59 \pm 0.56$; $C_{144} = -1.80 \pm 0.53$; $C_{166} = -7.57 \pm 0.87$; and $C_{456} = -0.42 \pm 0.23$. (auth)

3306 BAUSCHINGER EFFECT IN ANNEALED AND IRRADIATED TITANIUM. Gindin, A. I.; Lapiashvili, E. S.; Naskidashvili, I. A.; Nekliudov, I. M. (Physical Technical Inst., Kharkov). Probl. Prochnosti; 4: 118-120(Aug 1972). (In Russian).

Study of the influence of the degree of strain hardening on the value of the Bauschinger effect in VT1-1 polycrystalline titanium samples that were annealed and subsequently irradiated by fast (greater than 0.85 MeV) neutrons at a temperature of −100°C. As a result of the nonequilibrium concentration of radiation defects in the irradiated samples, the Bauschinger effect is not observed at the initial stage of plastic deformation, while at higher levels of strain hardening the value of the Bauschinger effect increases at a lower rate than that in nonirradiated annealed samples. (IAA)

3307 EPR IN SINGLE CRYSTALS OF SILICON IRRADIATED BY α PARTICLES. Gorelkinskii, Yu. V.; Sigle, V. O.; Chubisov, M. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz. Mat.; No. 4, 39-44 (1972). (In Russian).

EPR spectra of n- and p-type Si were studied by irradiating the samples with ~36-MeV α-particles at doses of $\sim 10^{16}$ $\alpha \cdot$ hr/cm^2. Paramagnetic centers detected were identified with Si−P1, Si−P3, Si−P4, and Si−P5 centers, which were produced by the irradiation of Si by fast neutrons. The isochronous annealing of the observed centers at 20 to 525°C was characterized. The profile of the concentration of Si−P3 centers was studied along the path of the α-particles. The rate of insertion of centers per α particle was $\sim 10^2$ times the rate for fast neutrons. (tr-auth)

3308 IRRADIATION EFFECTS AND GROWTH PROCESSES. Motoc, C. (Polytechnical Inst., Bucharest). Rev. Roum. Phys.; 17: No. 7, 871-882(1972).

Radiation effects on crystal growth are considered in this lecture. A short review is given of crystal growth theory. Irradiation generally increases the nucleation rate; homogeneous and heterogeneous nucleations are discussed. Results obtained by the author on potassium dihydrogen phosphate and Rochelle salt in gamma-ray fields are reviewed. Electron microscopy of recrystallization in metals is also briefly surveyed. The mechanism of bubble migration and void growth in irradiated materials is discussed. (40 references) (DLC)

3309 IRRADIATION EFFECTS ON STRUCTURAL MATERIALS. IV. Creep and Growth. Bement, A. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Rev. Roum. Phys.; 17: No. 5, 607-618(1972).

The complex processes that operate in the radiation creep in metals and alloys are summarized in tables for low and high stresses. Models for irradiation growth and creep are described for low ($T < 0.5\ T_m$) and high ($T \sim 0.5\ T_m$) temperatures. 33 references. (DLC)

3310 IRRADIATION EFFECTS ON STRUCTURAL MATERIALS. V. Void Swelling. Bement, A. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Rev. Roum. Phys.; 17: No. 5, 619-630(1972).

Swelling caused by void formation occurs in metals and alloys after neutron or heavy-ion irradiation at 0.3 to 0.6 T_m. The voids are usually polyhedral (in fcc metals, the shape is a truncated octahedron). Void formation data for several high-purity metals and alloys are summarized in tables. Swelling due to point defects or clusters is also important. The temperature and fluence dependences of void swelling in Type 304 stainless steel are discussed. The mechanisms of the void equilibrium, growth, and nucleation are considered in detail. 24 references, 6 figures. (DLC)

3311 "IN SITU" HEAVY-ION IRRADIATION IN THE ELECTRON MICROSCOPE. Johnson, E.; Carlsen, F.; Henriksen, L.; Ytterhus, J. A.; Wohlenberg, T. (Univ. of Copenhagen). Rev. Roum. Phys.; 17: No. 5, 603-605(1972).

To overcome the difficulty in the ion beam entering the electron microscope above the specimen at an angle, a small accelerator is attached to the bottom of the microscope, and the ion beam enters the bottom along the optic axis. With this arrangement, Al single crystals were irradiated by 12-keV Cs^+ ions along crystallographic directions, and the resulting damage was observed. (DLC)

3312 PINNING OF SINGLE CRYSTALS OF NIOBIUM IRRADIATED AT HELIUM TEMPERATURE. Andronikashvili, E. L.; Ashimov, S. M.; Tsakadze, J. S. (Inst. of Physics, Tbilissi, USSR). Phys. Status Solidi (b); 56: No. 1, 79-84(1 Mar 1973).

The influence of neutron irradiation at 4.2°K on the pinning of Abrikosov flux lines in single crystals of niobium was studied. It is shown that the irradiation with fast neutrons of 3.5×10^{12} cm^{-2} increases the mean value of the pinning force. Exposition of the specimen during 80 h at T = 100°K and the recooling do not eliminate the irradiation effect. It is assumed that the observed increase in the pinning force is caused by additional pinning of dislocations available in the specimen (pinning-centers) by point defects, formed during irradiation. (auth)

3313 IRRADIATION EFFECTS ON STRUCTURAL MATERIALS. II. Brittle Fracture. Bement, A. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Rev. Roum. Phys.; 17: No. 4, 505-517(1972).

The factors influencing the impact properties of steels and their response to neutron irradiation are discussed. Several fracture models (Ludwig−Davidenkov, Cottrell−Petch, Krafft−Irwin, Pellini, etc.) provide considerable insight into the effects of irradiation on fracture and the effects of grain size, defect distribution, dislocation processes, etc. The effects of residual elements on the radiation sensitivity of steel are also considered. (31 references, 7 figures) (DLC)

3314 IRRADIATION EFFECTS ON STRUCTURAL MATERIALS. III. High-Temperature Embrittlement. Bement, A. L. Jr. (Massachusetts Inst. of Tech., Cambridge). Rev. Roum. Phys.; 17: No. 4, 519-525(1972).

Neutron-induced helium has a strong effect on the elevated-temperature fracture of metals and alloys. The theory of helium-induced embrittlement at high temperatures is discussed with special reference to stainless steels. The importance of alloy composition and neutron spectrum in the choice of material for reactors is pointed out. (6 figures, 25 references) (DLC)

3315 VOID FORMATION IN NICKEL ON BOMBARDMENT WITH 100-keV Ni^{2+} IONS. Chen, W. W.; Silvent, A.; Sainfort, G. (CEN, Grenoble, France). J. Nucl. Mater.; 46: No. 3, 353-355 (Apr 1973). (In French).

The formation of voids in Ni bombarded at 500°C by 100-keV Ni^{2+} ions was studied. In the first series, the high-purity Ni was annealed before irradiation for 5 h at 900°C. The current density was varied from 5 to 90 μA/cm^2 and the irradiation time from 10^3 to 10^4 sec. In the second series, He was implanted in the Ni before irradiation. In the first series, only 5 of the same 40 foils examined showed voids distributed inhomogeneously in one or two regions of the foil. In the foils impregnated with He, homogeneously distributed voids were observed. In order to confirm the hypothesis of the void formation due to the presence of gaseous impurities, Ni was annealed under a poor vacuum and then bombarded. This led to a homogeneous distribution of voids. The formation of voids depends on the quantity and distribution of gaseous atoms in the lattice. (JSR)

3316 CAVITATION: STUDY OF MICROCRACK FORMATION AND PROPAGATION PHENOMENA IN CREEP-DEFORMED METALS. Piatti, G.; Lubek, R.; Matera, R. (Joint Research Centre, Ispra, Italy). Euro-Spectra; 11: No. 4, 93-101(Dec 1972).

Some metals and alloys undergo a loss of ductility at elevated temperatures and under irradiation. Techniques used to study the formation and propagation (cavitation) of microcracks are described: density measurement, quantitative metallographic analysis, electron microscopy, etc. Relative density vs time plots are graphed for various creep-deformed materials under different test conditions. Microcracks are formed at elevated temperatures by sliding at grain boundaries, while their propagation is due to diffusion and condensation of lattice vacancies as well as grain-boundary sliding. Merging of microcracks and loss of

cohesion followed by fracture are also considered. Measuring methods used at Ispra are described. (10 figures, 18 references) (DLC)

3317 INFLUENCE OF GAMMA RADIATION ON THE ELECTRICAL PROPERTIES OF A REAL GERMANIUM SURFACE. Lysenko, V. S.; Litovchenko, V. G.; Korniushin, S. I.; Chernopiskii, V. P. (Inst. of Semiconductors, Kiev). Poluprov. Tekh. Mikroelektron.; No. 7, 47-51(1972). (In Russian).

The influence of surface defects produced by gamma radiation on the properties of oxygen-containing n-type germanium samples and oxygen-free p-type samples was studied experimentally. It was found that the surface potential shifts toward the n-region in all samples and that the surface recombination rate in irradiated samples exhibits a pronounced increase as compared with the rate prior to irradiation. (IAA)

Other Materials

Refer also to abstracts 2280, 3032, 3304, 4503, 4512, 4525, 4573, 4631, 4632, and 4638.

3318 (CEA-CONF-2205) CHARACTERIZATION OF GRAPHITE POWDERS. Irradiation Behavior of Fuel Compacts in High Temperature Reactors. Mottot, P.; Fourre, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Societe Le Carbone Lorraine, Paris (France)). [nd]. 9p. (In French). (CONF-720609-10). Dep. NTIS (U. S. Sales Only) $3.00.

From international carbon conference; Baden-Baden, Federal Republic of Germany (26 Jun 1972).

Production of compacts by hot pressing of fuel particles overcoated with resinated graphite powder necessitated the investigation and characterization of different powders. These powders are produced either by crushing and micronization of natural graphite, or by crushing of coke and micronization after a graphitization treatment, or by crushing and micronization of artificial graphite. The powders are then purified and precoated with phenolformaldehyde resin containing hexamine. The characterization of the powders allows determination of their chemical purity, crystal structure, texture, and particule size distribution. Compacts containing particles overcoated with different powders have been fabricated. They have been irradiated in the RAPSODIE reactor to choose powders offering the best dimensional stability. (auth)

3319 (DP-Report-645) EXPERIMENTS WITH "C" TYPE AVICA SEALS. Dragon Project. Stringer, A. (Atomic Energy Establishment, Winfrith (England)). Jun 1969. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

It has been shown that when used in a flange with a seal cavity made according to the manufacturers instructions, the standard Avica Seal does not function effectively against high pressure helium unless coated with one of the soft low melting materials. The reasons for this have been indicated and methods of improving the performance of the seals by modifying the seal or seal cavity have been suggested. It has been shown that once an acceptable seal has been obtained, Avica Seals behave well under temperature variations of 20 to 400°C. Their limitations when used with mild steel flanges at temperatures above 300°C have been demonstrated. (auth)

3320 (DP-Report-654) X-RAYS ABSORPTION CORRECTIONS FOR BACON ANISOTROPY FACTOR MEASUREMENTS ON PyC. Dragon Project. Tassone, G. (Atomic Energy Establishment, Winfrith (England)). Aug 1969. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

A description is given of techniques used in deriving Bacon anisotropy factors. Curves for various applications are included with emphasis on derivations used in analysis of a parallel x ray beam impinging on the entire surface of the specimen. (JRD)

3321 (JINR-E4-6841) ANALYTICAL AND NUMERICAL RESULTS OF THE HUBBARD MODEL IN SIMPLE APPROXIMATIONS. Elk, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 19p. Dep. NTIS. (U. S. Sales Only) $3.00.

It is shown, that the results of both Hubbard's approach and the Hartree-Fock approximation are in a qualitative agreement. (auth)

3322 (LA-5233-PR) RESEARCH ON CARBON AND GRAPHITE. Quarterly Progress Report, October 1-December 31, 1972. Imprescia, R. J.; Resiwig, R. D.; Williams, J. M.; Honnell, R. E. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 28p. Dep. NTIS $3.50.

A commercial coal-tar pitch was separated into four major fractions and the influence of each on the development of crystallinity in carbons derived from them was studied. The pyrolysis behavior of coal-tar pitch, polyfurfuryl alcohol, phenolic resin, and a polyphenylene was studied and the advantages of each as binders and impregnants are discussed. Commercial and experimental graphites, and a carbon-carbon composite were impregnated with a coal-tar pitch or furfuryl alcohol resin. Effects of specimen size and impregnating conditions on saturation efficiency were studied. Organometallic compounds were used as sources of metal for forming fine dispersions of TiC, ZrC, VC, and TaC in carbons derived from coal-tar pitch or furfuryl alcohol resin. A series of ablation models, representing four high-strength experimental graphites, has been prepared and sent to NASA Ames Research Center for testing. The development of highly anisotropic polycrystalline graphites from ground pyrolytic graphite fillers for use in ablation applications has begun. (auth)

3323 (SLA-73-164) LOW STRESS SHOCK BEHAVIOR OF CELLULAR CONCRETE. Lee, L. M. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 24p. Dep. NTIS $3.25.

The shock compaction behavior of cellular concrete was determined as a function of curing time in the stress region from 0.5 to 4.5 kbar. Concrete samples cured 30 and 130 days were tested to evaluate the dependence of the shock compressional response on aging time. All of the experiments were conducted on vacuum dried samples (.7 g/cm^3), i.e., no free water. There were no measurable differences in the compaction behavior of the two materials, with complete void elimination occurring at approximately two kbar. Large differences were observed between the static and dynamic uniaxial strain response, however. Both the yield strength and the resistance to void compaction were much larger in the shock experiments than that observed in static uniaxial strain tests, and were attributed to rate dependent pore collapse in the cellular concrete. (auth)

3324 (SLA-73-208) STRUCTURES, PROPERTIES, AND PROCESS PARAMETERS OF MATRICES IN CARBON/CARBON COMPOSITES. Pierson, H. O.; Lieberman, M. L.; Smatana, J. F. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 30p. Dep. NTIS $3.50.

The various microstructures obtained by the low temperature (<1500°C) chemical vapor deposition (CVD) of carbon on carbon fiber substrates fall into three major types identified as rough laminar, smooth laminar, and isotropic. It is shown that the type of microstructure is a function of the temperature of deposition, the total gas pressure, and the carbon-to-hydrogen ratio of the source gas. These experimental results are found to be in good agreement with a previously reported carbon CVD model which relates the microstructure to the equilibrium gas phase C_2H_2/C_6H_6 mole ratio. The physical and crystallographic properties of the heat treated composites are significantly affected by the type of microstructure. The rough laminar material has by far the most graphitic characteristics and is followed by the smooth laminar and isotropic materials, in that order. (auth)

3325 (SRARI-P-168) METHOD OF MEASURING STORED ENERGY IN IRRADIATED MATERIALS. Gordienko, P. S. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 42p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.25.

A review of available methods and devices for stored-energy measurements in materials is given. The remote calorimetric Tian-Kal've type plant is described. The main plant characteristics and the stored energy values measured in some irradiated materials are given. Conclusions are drawn on the use of the plant for measurement of thermophysical properties. (20 figures, 28 references) (auth)

3326 IMPROVEMENTS IN OR RELATING TO FIBROUS MATERIAL FOR USE IN FORMING RADIATION-SHIELDING FABRIC. Ermolenko, I. N.; Lyubliner, I. P. (to Institut Obschei i Neorganicheskoi Khimii Akademii Nauk BSSR). British Patent 1,296,845. 22 Nov 1972. Filed date 4 Nov 1969. 6p.

A method is described for producing material comprising modifying cellulosic fibres to form acid groups in the cellulose without damaging the fibres, and then treating the modified fibres with an aqueous solution of a radiation-absorbent metal, such as Pb or Ba. The acid groups may be formed by esterification of the cellulose to form an acid ester, using phosphoric acid, citric acid, a monomer that forms with the cellulose a graft copolymer having acid groups, or an oxidising agent such as NO_2. Details are given for production of the fabric, and examples included. (UK)

3327 SELECTION RULES FOR INELASTIC NEUTRON SCATTERING BY MAGNETIC CRYSTALS. 1. The Symmetries of Magnetoelastic Waves and the Determination of Selection Rules for Magnon-Phonon Interactions, with an Application to Antiferromagnetic FeF_2. Cracknell, A. P. (Univ. of Dundee, Eng.). J. Phys., C (London); 6: No. 6, 1054-1062(28 Mar 1973).

It is shown how theory given by Herring (Phys. Rev. 52: 365-73(1937)) concerning accidental degeneracies in the electronic band structure of a crystalline solid can be adapted to the case of magnetoelastic waves in a magnetically ordered crystal. From this, it is possible to determine selection rules governing magnon–phonon interactions for dispersion relations along special lines of symmetry in the Brillouin zone. The theory is illustrated for antiferromagnetic FeF_2, on which inelastic neutron scattering studies of magnon–phonon interactions have recently been performed by Rainford, Houmann, and Guggenheim (to be published). (auth)

3328 POSSIBLE STRUCTURES FOR ALKALI IONS ON THE SURFACE OF ALKALI HALIDES. Al Jammal, Y.; Townsend, P. D. (Univ. of Sussex, Brighton, Eng.). J. Phys. C (London); 6: No. 6, 955-960(28 Mar 1973).

During the process of defect formation in alkali halides irradiated with 500-eV electrons, halogen atoms are ejected from the surface. In contrast the metal ions remain on the surface until they are thermally evaporated. Two extreme forms of this alkali layer are considered, namely, isolated alkali ions or a monolayer of an fcc alkali metal. A simple electrostatic calculation favours the isolated ion model. (auth)

3329 SPATIAL DISTRIBUTION OF DEPOSITED ENERGY AND LATTICE DEFECT IN SEMICONDUCTORS BOMBARDED WITH ENERGETIC HEAVY IONS. Tsurushima, T.; Tanoue, H. (Electrotechnical Lab., Tokyo). Denshi Gijutsu Sogo Kenkyusho Iho; 36: No. 7, 495-515(Jul 1972). (In Japanese).

A new method is described for predicting the spatial distribution of the energy absorbed in nuclear collision process, especially the nuclear collision causing atomic displacement, in semiconductor materials bombarded by heavy ions. The present method is based on the theory given by Lindhard, Scharff, and Schiott. An energy distribution function of incident ions at arbitrary penetration depth was derived to calculate energy discharge rate into atomic displacement, and it was obtained by multiplying total cross section of collision for the production of displaced atoms and average transfer corresponding to the collision for the production of displaced atoms in substrate materials as weight function to the energy distribution function, and integrating them. Numerical data for the collision of various ions with Si substrate are presented for each step and compared with theoretical and experimental attempts. The calculated total energy absorbed in the primary nuclear collision is in good agreement with the sum of the primary elastic energy transfer. The energy discharge rate in the atomic displacement process is a little smaller than the discharge rate in the nuclear collision. Average number of knock-on atoms produced by incident ions and associated knock-on atoms was calculated. Problems of vacancy distribution and criterion of making the amorphous state are discussed. The obtained vacancy distribution can explain experimental results on the depth of damaged layer in Si. (Japan)

3330 ION-IMPLANTATION DOPING OF COMPOUND SEMICONDUCTORS. Degen, P. L. (Brunel Univ., Uxbridge, Eng.). Phys. Status Solidi (a); 16: No. 1, 9-24(16 Mar 1973).

This review discusses range of implanted ions, radiation damage, doping of semiconductors (structures, conditions, profile, measurement techniques, EPR), and studies on particular compounds (III-V, II-VI, and SiC). (17 figures, 5 tables, 96 references) (DLC)

3331 SLOW DECAY OF EXOELECTRON EMISSION OF X-IRRADIATED KCl : Tl CRYSTALS. Huzimura, R.; Morishita, T. (Nara Univ. of Education, Japan). Phys. Status Solidi (a); 16: No. 1, K5-K7(16 Mar 1973).

A study was made of the decay of exoelectron emission (EE) with time constants over 100 s, which corresponds to the thermal dissociation of Tl^0. F-light stimulation after x-irradiation induces growth of EE and after stopping the illumination, a slow-decay follows a fast one; the slow one may be interpreted as due to electrons combining with Tl^+ to form Tl^0 centers which then decay. The EE and Tl^0 absorption decays may be resolved into two components; the temperature dependence of the slower decay indicates activation energies of 0.30 ± 0.03 eV for EE and 0.41 ± 0.03 eV for Tl^0 absorption. Both energies are inferred to be associated with thermal ionization of Tl^0 centers. (DLC)

3332 MAGNETIC PHASE DIAGRAM OF $UAs_{2-x}Se_x$ SOLID SOLUTION. Ligenza, S. (Inst. of Nuclear Research, Warsaw); Murasik, A.; Zygmunt, A.; Leciejewicz, J. Phys. Status Solidi (a); 16: No. 2, K171-K174(16 Apr 1973).

The $UAs_{2-x}Se_x$ system was studied by neutron diffraction for x = 0, 0.5, 0.6, 0.65, 0.75, and 1. Lattice parameters and atomic locations were also determined. For x = 0.5, neutron diffraction at 4.2°K shows a single antiferromagnetic phase. With increase of Se content, the antiferromagnetic peaks decrease in intensity, and the (101) nuclear peak becomes more intense. $UAs_{1.25}Se_{0.75}$ is a single ferromagnetic phase. In a fairly broad composition range, both the antiferromagnetic and ferromagnetic phases are present. The exchange integrals which determine whether ferromagnetism or antiferromagnetism is present, are discussed. Collinear moment alignment was observed in this study. (DLC)

3333 SPUTTERING OF ROUGH CYLINDERS: APPLICATIONS TO THE THINNING OF FIBRES FOR TRANSMISSION ELECTRON MICROSCOPY. Goodhew, P. J. (Surrey Univ., Guildford, Eng.). J. Mater. Sci.; 8: No. 4, 581-589(Apr 1973).

Thinning by ion bombardment is a useful technique for the preparation of carbon and other fibres for transmission electron microscopy. It is shown that the presence of axial ridges on the initial fibre leads to the development of striations perpendicular to the axis of the thinned specimen. An analysis of the variation of ion incidence angle on a rotating cylinder enables the change in shape of a fibre on sputtering to be explained; scanning electron microscopy of sputtered fibres confirms these conclusions. A mechanism for the formation of striations perpendicular to pre-existing ridges on the fibre is proposed. (auth)

3334 SAMPLE HOLDER FOR MEASUREMENT AND ANODIC OXIDATION OF ION IMPLANTED SILICON. Ryssel, H.; Schmid, K.; Mueller, H. (Technische Univ., Munich). J. Phys., E (London); 6: No. 5, 492-494(May 1973).

A versatile sample holder for Hall effect and sheet resistivity measurements and for anodic oxidation of silicon was developed. The main feature of the design is the use of a Teflon edge instead of a rubber or Viton seal for defining the area to be stripped. In this way very good sealing is obtained and severe problems in obtaining well-defined etching areas are overcome. It is possible to etch areas from 1.25-mm diameter to 20-mm diameter with constant depth scale. Hall and sheet resistivity measurements can be performed without removing the sample from the holder. (auth)

3335 DECAY KINETICS OF THERMOLUMINESCENCE IN γ-IRRADIATED-COBALT CHELATE. A New Model. Charlesby, A. (Royal Military Coll. of Science, Shrivenham, Eng.); Gupta, S. S.; Sarup, S. Int. J. Radiat. Phys. Chem.; 5: No. 2, 141-148 (Mar 1973).

Thermoluminescence (glow) curves of an irradiated cobaltate complex show two broad peaks, ascribed to electron untrapping and recombination with positive charges. Both intensity and peak temperature of the lower temperature peak change if the specimen is left standing at room temperature, but the kinetics do not appear to agree with either a single trap depth or a wide range of trap depths. Competition between retrapping and combination with positive charge offers a more satisfactory explanation. (auth)

3336 PARAMAGNETIC CENTERS IN SILICON IRRADIATED WITH HEAVY CHARGED PARTICLES. Botvin, V. A.; Gorelkinskii, Yu. V.; Sigle, V. O.; Chubisov, M. A. (Inst. of High Energy Physics, Alma-Ata, USSR). Sov. Phys. Semicond. (Engl. Transl.); 6: No. 9, 1453-1456(Mar 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 9, 1683-1686 (Sep 1972).

The ESR method was used to study paramagnetic centers generated in silicon single crystals by irradiation with 37-MeV α particles or 9-MeV protons at 273°K. The experiments were carried out on silicon grown by the floating-zone and Czochralski methods and doped with ^{31}P, ^{11}B, and ^{27}Al. The existence of Si-P3, Si-P1, Si-P4, Si-P5, Si-S1 (Si-B2), and Si-S2 centers was established in the proton-irradiated samples. The Si-S1 and Si-S2 centers were not found in the α-irradiated silicon. The characteristics of isochronous annealing of the various centers were determined. The distribution of the paramagnetic centers along the trajectories of the incident particles was determined by successive removal of silicon layers from the irradiated side. The rates of introduction of the paramagnetic centers by α particles and protons were estimated. (auth)

3337 ELECTRICAL PROPERTIES OF SEMICONDUCTORS WITH NONSPHERICAL RADIATION-DAMAGE REGIONS. Litvinov, V. L.; Sadikov, V. P.; Ukhin, N. A. (Inst. of Atomic Energy, Moscow). Phys. Status Solidi (a); 16: No. 2, K101-K103(16 Apr 1973).

Irradiation of Ge, Si, and GaAs by 26-MeV electrons produced nonspherical radiation damage regions (Fiz. Tekh. Poluprov., 6: 536(1972)). Gossick's model was used to calculate the Hall field inside such regions for three orientations of electric and magnetic fields relative to the ellipsoid axes. Equations were derived for the Hall and drift mobilities; they are valid to within terms of the first order in f, the fraction of the volume occupied by the damage regions. (DLC)

3338 INVESTIGATION OF PROTON RADIATION DAMAGE OF Si AND Ge SINGLE CRYSTALS BY THE SHADOW EFFECT. Kolyada, V. M.; Zlobin, V. G.; Zaporozhets, I. A. (All-Union Scientific-Research Inst. of Analytic Instrument Manufacture, Kiev). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 9, 1565-1567(Mar 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 9, 1813-1816 (Sep 1972).

The relative change of the depth of the axial shadow $\Delta\delta_{min}$ in the scattering of fast protons was used as a measure of the concentration of structure defects. Si and Ge single crystals with surfaces parallel to the (111) plane were bombarded with 43- to 83-keV protons. The data were used to calculate the rate of introduction of defects. Results show that the rate of accumulation of amorphous zones is proportional to $1/\Delta\delta_{min}^{sat}$. (DLC)

3339 RADIATION ANNEALING OF DEFECTS FORMED BY ION BOMBARDMENT OF CRYSTALS. Gerasimenko, N. N.; Dvurechenskii, A. V.; Kachurin, G. A.; Pridachin, N. B.; Smirnov, L. S. (Inst. of Semiconductors, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 9, 1588-1589(Mar 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 9, 1834-1835 (Sep 1972).

The recovery of the crystal structure of GaAs and Si, made amorphous by 40-keV Ar ions, was studied. Three methods were used to study the structure changes: conductivity of disordered layers in semi-insulating GaAs, paramagnetic centers in Si, and electron diffraction from surface layers. 3.5-MeV electrons were initially used in an attempt to accelerate the annealing in GaAs, but doses up to 10^{17} e/cm^2 had no effect unless temperatures ≥250°C were also used. 10-keV protons were found to accelerate annealing so that amorphization disappears at 200 to 250°C instead of 500°C. (DLC)

3340 X-RAY SPECTRAL INVESTIGATION OF CERTAIN VANADIUM COMPOUNDS WITH THE Cr_3Si STRUCTURE. Dzeganovskii, V. P.; Bondarenko, T. N.; Zhurakovskii, E. A.; Matveeva, N. M.; Pan, V. M. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1396-1399(Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1591-1594(Sep 1972).

Data are given on the $L\alpha_{1,2}$ bands of vanadium in pure vanadium, V_3Si, V_3Ga, V_3Ge, V_3Co, and V_3Sn. For V_3Si, the K and L spectra of vanadium are compared and certain conclusions drawn on the structure of the valence band of V_3Si. Experimental results are compared with the theoretical results on the energy distribution of N(E) states.

3341 APPLICATION OF RADIATION DOPING IN FABRICATION OF UNIFORM STANDARD SILICON SPECIMENS (EXCHANGE OF EXPERIENCE). Batavin, V. V.; Kuznetsov, Yu. N.; Perezhogin, G. A.; Pantuev, V. S.; Popova, G. V. Ind. Lab. (USSR) (Engl. Transl.); 38: No. 7, 1041-1042(Jul 1972).

Translated from Zavod. Lab.; 38: No. 7, 819-820(Jul 1972).

P-type Si (5000 Ω · cm) was exposed to a slow neutron flux (10^{13} n/cm^2 s) and then allowed to stand 4 days for complete decay of the formed ^{31}Si to ^{31}P. Annealing at 650°C for 30 min was used to remove the radioinduced defects. After neutron exposure times of 440, 220, 110, and 22 h, the resistivity was 1.4, 2.8, 5.6, and 27 Ω · cm. In order to estimate the uniformity of doping, the resistivity and breakdown voltage were measured by four- and three-probe methods. (DLC)

3342 EFFECT OF ATOMIC DISPLACEMENT ON DECHANNELING. Matsunami, N.; Itoh, N. (Nagoya Univ., Japan). Phys. Lett.; 43A: No. 5, 435-436(9 Apr 1973).

The component of the diffusion coefficient originating from the displaced atoms in the ⟨100⟩ string of KCl was calculated. The diffusion equation was solved to estimate the dechanneling cross section of a displaced atom and the obtained results were compared with those obtained with the single scattering model. (auth)

3343 ANNEALING OF γ-IRRADIATION-INDUCED HARDENING IN NaCl. Lerma, I. S.; Agullo-Lopez, F. (Junta de Energia Nuclear, Madrid). Phil. Mag.; 27: No. 4, 993-997(Apr 1973).

Data on the thermal and optical annealing of γ-irradiation-induced hardening of NaCl are reported. Mechanical tests were performed at room temperature and at liquid nitrogen temperature. For crystals irradiated into the late stage of the colouring, isothermal annealing data at temperatures ≲ 200°C suggest the dissolution of the interstitial clusters formed during the irradiation. At ~300°C, the recovery of the crystals is complete. On the other hand, the temperature dependence of the hardening for bleached samples indicates that interstitial clusters are essentially stable throughout the bleaching process. (auth)

3344 CHARGE-CLOUD DISLOCATION DAMPING IN IONIC CRYSTALS. Tallon, J. L.; Robinson, W. H. (Dept. of Scientific and Industrial Research, Lower Hutt, New Zealand). Phil. Mag.; 27: No. 4, 985-988(Apr 1973).

An error of sign in the Robinson–Birnbaum (J. Appl. Phys., 37: 3754 (1966)) charged dislocation–charge cloud theory of mechanical damping in ionic crystals is corrected, and the rather limited available data are interpreted in terms of the corrected theory. The formula for maximum damping is unchanged from that obtained previously, while on passing through an isoelectric temperature the damping may or may not go through a peak depending on the size of $\omega_p^2 A/(B_0 \ln(\omega(\max)\theta))$. To explain changes in damping in LiF on irradiation, a very large effective dislocation mass ($\sim\pi\rho(100b)^2$) must be assumed while the average dislocation loop length is shown to be of the order of 10^{-6} m. Changes in damping with temperature suggest a value between 1.0 and 1.3 eV for the energy of motion of the active charge cloud defect in LiF at temperatures between 77 and 298°K. (auth)

3345 ROLE OF MOISTURE IN THE ATMOSPHERIC OXIDATION OF SILICON. Roikh, I. L.; Belitskaya, S. G.; Ordynskaya, V. V. (Odessa Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1340-1342(Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1525-1528(Sep 1972).

The atmospheric oxidation of Si is markedly influenced by the atmospheric humidity: the process is faster when the air is wetter. The surface film formed on silicon during atmospheric oxidation is complex in composition. Preliminary gamma irradiation of the specimens, which increases the work function of the electrons, retards the growth of the surface film. The influence of humidity and electron work function on the oxide film growth rate indicates that atmospheric oxidation of Si has an electrochemical mechanism. (auth)

3346 THERMOLUMINESCENCE OF IRRADIATED ORTHOVANADATES OF GROUP III ELEMENTS. Khodes, M. Ya., Shul'gin, B. V. (Ural Polytechnic Inst., Sverdlovsk, USSR). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 9, 1475-1476(Sep 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 9, 1678-1679(Sep 1972).

An investigation of the thermoluminescence of x-irradiated orthovanadates of Y, Sc, In, and Tl is reported. Thermoluminescence (TL) is observed for vanadates treated with x-rays at 95°K (treatment with x rays at 295°K has no effect). The TL brightness is highest in the case of $ScVO_4$; the TL of $TlVO_4$ is very weak. If the peak intensity at 120°K in $ScVO_4$ is taken at 100 units, the TL intensity of YVO_4 and $InVO_4$ is 2 and 3, respectively. (DHM)

3347 UGLEGRAFITOVYE MATERIALYJ (SPRAVOCHNIK). (Carbon-Graphite Materials: a Reference Book). Marmer, E. N. Moscow; Metallurgiya (1973). 136p.

A survey is made of the uses of carbon materials and the industry which produces them. Most of the book deals with the properties of graphite; 25 graphs and 55 tables are concerned with its thermal, electrical, stability, frictional, vacuum, and nuclear properties. Applications of graphite to chemistry, electric furnaces, and other uses are summarized. (240 references) (KSW)

3348 COLLISION THEORY OF DISPLACEMENT DAMAGE, ION RANGES, AND SPUTTERING. Sigmund, P. (Univ. of Copenhagen). Rev. Roum. Phys.; 17: No. 7, 823-870(1972).

These lectures discuss interatomic potentials, scattering of ion beams, and stopping theory. The theory of slowing down of ions and collision cascades is presented in detail, with emphasis on the derivation and solution of integral equations (connected closely to the Boltzmann transport equation). The main part of the lectures deals with random collision processes, with occasional reference to low-energy collision dynamics and to the channeling effect. (24 figures, 91 references) (DLC)

3349 RADIOINDUCED CHANGES OF ELECTRIC PROPERTIES OF NORMAL AND DEUTERATED TRIGLYCINE SELENATE OVER THE PHASE TRANSITION ZONE. Lagutina, Zh. P.; Varikash, V. M.; Zarembovskaya, T. A.; Pupkevich, P. A. (Minsk Radiotechnical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 10, 127-129(1972). (In Russian).

This paper represents a continuation of work begun in 1969 on the effect of large doses of γ radiation on the dielectric properties of triglycine selenate (TGS) in the region of the phase transition. TGS was crystallized both from normal water and from heavy water (99.6% D), and then irradiated with a ^{60}Co source. Increase in the radiation dose resulted in a decrease in the dielectric permeability. The permeability of irradiated and nonirradiated TGS was investigated as a function of temperature from 10 to 50°C: for a dose of 1.68×10^8 R, the permeability is practically

independent of temperature; otherwise sharp maxima were observed. (KSW)

3350 OPTICAL ABSORPTION IN NEUTRON-IRRADIATED GALLIUM PHOSPHIDE. Pivovarov, V. Ya.; Tkachev, V. D. Zh. Prikl. Spektrosk.; 18: No. 2, 283-288(Feb 1973). (In Russian).

The optical absorption of unirradiated and neutron-irradiated GaP crystals was determined. The observed supplementary structureless absorption beyond the edge of the natural absorption was increased proportionally to the neutron flux, and was linked with microscopic regions of disorder. When epitaxial crystals of GaP were used in these tests, the irradiated samples produced absorption bands as a result of local vibrations of radiation-induced or residual defects. The photon absorption cross section was determined by free carriers, and its dependence on the wavelength of the incident light was studied. (tr-auth)

3351 HYPERFINE INTERACTION OF RECOIL NUCLEI. Gelberg, A. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 4, 459-472(1972).

This lecture shows how the perturbation of angular correlations produced by hyperfine fields (interactions of nuclear magnetic dipole and electric quadrupole moment with external magnetic field and electric field gradient) can be used in studies of the interaction of recoil nuclei with solids. The use of PAC in radiation damage studies is illustrated with results on Re compounds irradiated by neutrons; G_2, G_4 plots are given for $NaReO_4$, NH_4ReO_4, and K_2ReCl_6. The case of Coulomb excitation (CE) is next considered, and the evolution on the recoil ion produced by CE in a thin target is described. The IMPAC technique, using CE, is discussed, and discrepancies between experiment and theory are pointed out. (13 figures, 17 references) (DLC)

3352 SOFT X-RAY APPEARANCE POTENTIAL SPECTRUM OF GRAPHITE AND LESS WELL-ORDERED CARBONS. Bradshaw, A. M.; Menzel, D. (Technische Univ., Garching, Ger.). Phys. Status Solidi (b); 56: No. 1, 135-144(1 Mar 1973).

The technique of soft x-ray appearance potential spectroscopy (APS) was applied to pyrolytic graphite and other carbons. The prominent, sharp satellites in the spectrum are assigned, in agreement with Houston and Park, to a coupling of the C_K core-hole excitation to strong plasmon emission (first and higher orders of the 7 eV plasmon and first order of the 27 eV plasmon). However, the peak separations of the higher-order 7-eV plasmons are found to be not constant. The broad loss peaks are assigned to coupling with interband transitions. Increasing the degree of disorder of the carbon markedly affects the spectrum. The results are discussed in the light of more direct experimental investigations of electronic excitations in graphite, and of recent theoretical considerations of plasmon coupling in APS. (auth)

3353 NOVEL REDUCTION PROCEDURE FOR THE PREPARATION OF PURE SmF_2, EuF_2, YbF_2, SmS, YbS, AND EuO. Petzel, T.; Greis, O. (Univ., Freiburg, i. B.). Z. Anorg. Allg. Chem.; 396: No. 1, 95-102(Feb 1973). (In German).

A technique is described, by which the compounds of SmF_2, EuF_2, YbF_2, SmS, YbS, and EuO can be prepared by reduction of the trifluorides, sesquisulfides, and of europium sesquioxide, respectively, with the gaseous rare earth metals. By this technique the contamination of the reaction products with several specific impurities, usually contained in the condensed rare earth metals, can be avoided. Analytical data and lattice parameters of the compounds prepared by this method are given. (auth)

3354 COMPUTER SIMULATIONS OF MOESSBAUER SPECTRA FOR AN EFFECTIVE SPIN S = ½ HAMILTONIAN. Muenck, E.; Groves, J. L.; Tumolillo, T. A.; Debrunner, P. G. (Univ. of Illinois, Urbana). Comput. Phys. Commun.; 5: No. 3, 225-238 (Mar 1973).

A computer program is described that calculates the Moessbauer spectrum of ^{57}Fe in paramagnetic polycrystalline samples in an external magnetic field. The program, named MOSSSPEC, is written in FORTRAN IV for IBM 360/75. (DLC)

3355 CONCRETE FOR NUCLEAR REACTORS. Volume I. Conference held at Berlin, October 5–9, 1970. Kesler, C. E. (ed.). Special Publication SP-34. Detroit; American Concrete Institute (1972). 645p. (CONF-701007–(Vol. 1)).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970).

Thirty-two papers are presented in this volume under the following session headings: setting the scene, what the designer needs to know about concrete for radiation shielding and reactor vessels, application of concrete properties in design calculations, strength of concrete under different states of stress, and effects of elevated temperature on strength different properties, and creep concrete. Separate abstracts were prepared for all 32 papers. (DLC)

For abstracts of individual papers see: 3356–3376, 4524, 4562, 4572, 4600, and 4630–4636.

3356 PRELIMINARY RECOMMENDATION FOR DESIGN, MAKING, AND CONTROL OF RADIATION-SHIELDING CONCRETE STRUCTURES. Pihlajavaara, S. E. (State Inst. for Technical Research, Helsinki). pp 57-67 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

The recommendation is a guide for a builder of different types of hot-cell concrete walls against gamma or neutron radiation. It serves also for an introduction to more complicated shielding problems in which, e.g., simultaneous gamma and neutron radiation, high radiation intensities, and temperature loads have to be taken into account. (auth)

3357 STRAIN AND ULTIMATE STRENGTH OF CONCRETE UNDER TRIAXIAL STRESS. Launay, P. (Compagnie Industrialle de Travaux, Paris); Gachon, H. pp 269-282 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

The paper describes and analyzes measurements made in 1968–1969 on cubic specimens of concrete with a view to studying the deformability under service compression stresses and the failure strength of the thick concrete walls used in nuclear reactor caissons. The deformability (Young's modulus, Poisson's ratio) was studied up to 500 bars in the three principal directions on cubes having 140-mm sides at 20, 40, and 60°C. The ultimate strength and the failure mechanism under pluriaxial stresses were studied on cubes having 70-mm sides up to 2000 bars in all three directions, with the same specially built testing machine. The specimens were concreted with the same materials as the two ⅕ models of the BUGEY I caisson built in Chinon: CPAC-325 cement, silico-calcareous gravel having a maximum grain size of 15 mm, but with two different batchings, the nominal uniaxial strength at 28 days varying in consequence from 300 to 450 bars. (10 figures) (auth)

3358 TRIAXIAL STRENGTH CRITERION FOR CONCRETE. Bremer, F. (Fried.-Krupp, GmbH, Essen). pp 283-294 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A strength criterion is presented for concrete based on triaxial loads rather than the usual monoaxial compressive strength, tensile strength, and shear strength. Prestressed concrete pressure vessels used in nuclear reactors are invariably subjected to multiaxial stress and an effort is made to develop an analytical method to take these multiaxial stresses into account. (auth)

3359 CONCRETE STRENGTH IN MULTIAXIAL STRESS STATES. Hansson, V.; Schimmelpfennig, K. (Ruhr-Univ., Bochum, Ger.). pp 295-311 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A strength criterion is presented for concrete in multiaxial compression. The strength criterion is based on biaxial and triaxial compressive strength tests on cubes, cylinders, and slabs. (13 references, 7 figures) (auth)

3360 STRENGTH OF CONCRETE UNDER UNIAXIAL SUSTAINED LOADING. Stoeckl, S. (Technische Hochschule, Munich). pp 313-326 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

Based on the results of 15 years of study, the strength of concrete under sustained loading is investigated. The strength of concrete subjected to long-time loads of varying magnitude and time is compared with the strength obtained with short-time tests. (10 references, 9 figures) (auth)

3361 STRENGTH OF CONCRETE UNDER BIAXIAL SUSTAINED LOAD. Linse, D. (Technische Univ., Munich). pp 327-333 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A report on the strength of concrete under long-term sustained loads is presented. The specimens are biaxially loaded for long terms and their strength is compared to short-term strength tests. (auth)

3362 STRENGTH OF CONCRETE UNDER DIFFERENT STATES OF STRESS. Garas, F. K. (Taylor Woodrow Construction, Ltd., Southall, Eng.). pp 335-343 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A summary is given of the development of failure envelopes for concrete under multiaxial stress conditions. (2 tables, 7 figures) (auth)

3363 ANALYSIS OF THE FACTORS EXERTING EFFECT ON STRENGTH AND OTHER PROPERTIES OF CONCRETE AT ELEVATED TEMPERATURES. Pihlajavaara, S. E. (State Inst. for Technical Research, Otaniemi, Finland). pp 347-354 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

The factors affecting concrete at high temperatures are discussed. When evaluating the effect of temperature history and temperature on concrete, nearly 20 factors must be taken into account. The lack of consideration of these factors in existing investigations on the subject matter has led to great, confusing variations in data, and even into contradictory results. Therefore, at the present state of knowledge, the utilization of the results available must be done very carefully. (auth)

3364 LONG-TERM TESTS ON THE EFFECT OF MODERATE HEATING ON THE COMPRESSIVE STRENGTH AND DYNAMIC MODULUS OF ELASTICITY OF CONCRETE. Mears, A. P. (Sir Robert McAlpine and Sons, Ltd., London). pp 355-375 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

As concrete pressure vessels are intended to have a working life of 30 years or more it is of prime importance to know the effect of operating temperatures on the properties of concrete at all ages. Various concretes and heat treatments to 65°C have been used in the laboratory and the effects on compressive strength and dynamic modulus of elasticity have been studied for up to 13 years. The results so far obtained indicate that, in general, a decrease in strength and modulus of elasticity occurs on the first heating and for practical purposes subsequent heating to the same temperature does not cause further losses. (19 figures, 3 tables) (auth)

3365 STRENGTH, ELASTICITY, AND THERMAL PROPERTIES OF CONCRETE SUBJECTED TO ELEVATED TEMPERATURES. Harada, T. (Kanagawa Univ., Tokyo); Takeda, J.; Yamane, S.; Furumura, F. pp 377-406 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A study was made of the reduction of strength and elasticity of concrete during and after heating at elevated temperatures. The variations in thermal properties of concrete at high temperatures using aggregates of various qualities are also considered. It was found that the various thermal properties of concrete were influenced by the type of aggregate and further affected when, with a rise in temperature, it was found that the mechanical properties are impaired with temperature rise. (10 references, 15 figures, 7 tables) (auth)

3366 STRENGTH AND INELASTIC PROPERTIES OF CONCRETE AT ELEVATED TEMPERATURE. Nishizawa, N. (Chuo Univ., Tokyo); Okamura, H. pp 407-421 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

Experiments on strength, Young's modulus, Poisson's ratio, and creep of concrete exposed to elevated temperatures were carried out. Based on the results of experiments, strengths of sealed specimens stored at elevated temperatures and the creep strains of prestressed specimens exposed to elevated temperatures or exposed to cycles of temperature changes are described, and some problems in application of concrete for nuclear reactors are discussed. (10 figures) (auth)

3367 CUBE AND PRISM STRENGTH OF CONCRETES AT ELEVATED TEMPERATURES. Desov, A. E.; Nekrasov, K. D.; Milovanov, A. F. (Scientific Research Inst. of Concrete and Reinforced Concrete, Moscow). pp 423-434 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A series of experiments on various heavy-weight aggregate concretes subjected to high temperatures is given. The compressive strength of both cubic and prismatic specimens was obtained to investigate the properties of heavy-weight aggregate concretes used in radiation shielding. (14 references) (auth)

3368 EFFECTS OF ELEVATED TEMPERATURE ON THE PROPERTIES OF CONCRETE FOR THE CONTAINMENT AND SHIELDING OF NUCLEAR REACTORS. Kaplan, M. F.; Roux, F. J. P. (Univ. of Cape Town). pp 437-441 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

Investigation on the structural properties of concrete made with South African aggregates are reported. Nuclear power stations are to be built in the Republic of South Africa, and the investigations have been carried out to help decide the type of reactor to be selected. (auth)

3369 STUDIES ON THE TECHNOLOGY OF CONCRETES UNDER THERMAL CONDITIONS. Crispino, E. (Nuclear Fuel Labs., Milan). pp 443-479 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol. 1).

A research program sponsored by EURATOM to develop a concrete made of readily available components capable of being used at high temperatures as structural material for nuclear reactor pressure vessels is presented. (17 figures, 4 tables) (auth)

3370 INFLUENCE OF HIGH TEMPERATURES ON STRENGTH AND DEFORMATIONS OF CONCRETE. Weigler, H.; Fischer, R. (Technical Univ., Darmstadt, Ger.). pp 481-493 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

If concretes of portland and blast furnace cement with quartz and baryta aggregates are exposed unloaded to temperatures up to 300°C, a strength decrease of about 20% is to be expected. This strength decrease is reduced (quartz aggregate) or prevented (baryta aggregate) when the concrete is loaded during the exposure. The optimal load for this effect is about one-third to one-half of the normal compressive strength. The temperature expansion of the concrete is then strongly diminished. The strain progress indicated fatigue and hardening effects at temperatures of 150 to 300°C. After cooling, considerable remaining strains appeared. During repeated temperature exposure, the strains of the second and all following cycles correspond to those of unloaded concrete. (6 figures, 3 tables) (auth)

3371 VARIATIONS IN THE MODULUS OF ELASTICITY AND POISSON'S RATIO WITH TEMPERATURE. Marechal, J. C. (Centre Experimental de Recherches et d'Etudes du Batiment et des Travaux Publics, Paris). pp 495-503 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

Experimental results are given drawn from the study of the properties of concrete from −160°C to +500°C. The variations in the modulus of elasticity and the Poisson ratio varying with the change of state and temperature are discussed in relation with the other thermodynamic properties of the material. (7 figures) (auth)

3372 INFLUENCE OF THERMAL EXPOSURES ON MECHANICAL CHARACTERISTICS OF CONCRETE. Bertero, V. V.; Polivka, M. (Univ. of California, Berkeley). pp 505-531 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

A report on the first phase of a program of investigation of the mechanical properties of concrete subject to high temperatures is presented. The first phase had two objectives: (1) to evaluate

instrumentation and techniques and (2) to study the effect of temperature on the mechanical characteristics of concrete under uniaxial stress. (10 figures, 2 tables) (auth)

3373 EXPERIMENTAL DETERMINATION OF POISSON'S RATIO FOR CREEP. York, G. P.; Kennedy, T. W.; Perry, E. S.; Thompson, J. N. (Univ. of Texas, Austin). pp 535-546 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1)j.

An investigation of creep Poisson's ratio for concrete under continuous load is presented. The objective of the investigation was to study the creep behavior of concrete subjected to multiaxial state of stress and elevated temperatures. (8 references, 6 figures) (auth)

3374 CREEP OF CONCRETE AS A FUNCTION OF TEMPERATURE. Marechal, J. C. (Centre Experimental de Recherches et d'Etudes du Batiment et des Travaux Publics, Paris). pp 547-564 of Concrete for Nuclear Reactors. Vol. I, Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1)j.

Shrinkage and creep under different stresses were studied on several specimens of concrete. Once analyzed and discussed, the experimental results reveal to two classes of distinct phenomena: at high temperatures, the concrete, freed of its evaporable water, would appear to behave according to the classical Arrhenius equation during changes in state; for lower temperatures, pure creep due to temperature would be very slight, and shrinkage and shrinkage under loading would vary with the steam pressures bringing about the desorption of evaporable water. (10 figures) (auth)

3375 EFFECT OF TEMPERATURE ON CREEP OF CONCRETE: A LITERATURE REVIEW. Geymayer, H. G. (Waterways Experiment Station, Vicksburg, MS). pp 565-589 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1)j.

A review of the literature on the effect of elevated temperatures on the time-dependent volume change due to load (creep) of concrete reveals incomplete and conflicting evidence. Some workers have found a "creep maximum" at a particular temperature range; others have not encountered this phenomenon. Among those who have found it, there is lack of agreement as to what the range is. All available data are collected, reduced to comparable form, and analyzed. The analysis is reviewed in the light of the several theories of the mechanism of concrete creep. It is concluded that the new results on temperature effects on creep do not resolve the conflicts among the various creep theories, but they tend to support the seepage theory more than any other. Many factors affecting creep are found to be influential at elevated temperatures in analogous fashion to their influence at room temperature. These factors include time under load, applied stress, maturity of concrete, and moisture content of concrete. The effect of temperature, at least up to 50°C, is to increase creep by a factor of two or three at 50°C. Creep may or may not increase from 50 to 100°C, or it may increase sometimes and not increase other times. The limited data on tests at temperatures above 100°C are not in agreement. A program of testing in the range −35 to 149°C using stress/strength ratios of 0.20, 0.40, and 0.60, including periods of sustained load of up to 2 to 3 years, is proposed. (34 references, 4 figures, 2 tables) (auth)

3376 CREEP OF CONCRETE AT ELEVATED TEMPERATURES. Seki, S. (Nihon Univ., Tokyo); Kawasumi, M. pp 591-638 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.1)j.

Creep tests of concrete at 20, 40, and 70°C were carried out. The cement used was normal portland cement, the weight of cement per unit volume of concrete was 343 kg/m^3 and the water/cement ratio was 0.40. Numerical expressions were given to the creep curves. Losses in weight of concrete due to evaporation of water were measured, and their relation to drying shrinkages was examined. Also diffusion coefficients of water in concrete were calculated with formulas including the new one. A formula expressing the rate of hydration of cement as a function of w/c and age is presented. Coefficients of viscosity of leaching water from concrete were measured at various temperatures. (6 references, 23 figures, 11 tables) (auth)

3377 CONCRETE FOR NUCLEAR REACTORS. Volume II. Conference Held at Berlin, October 5–9, 1970. Kesler, C. E. (ed.). Special Publication SP-34. Detroit; American Concrete Institute (1972). 542p. (CONF-701007–(Vol.2)).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970).

Twenty-one papers are presented in this volume under the following session headings: triaxial creep of concrete, behavior of concrete and concrete structures under long-term thermal influences, moisture migration in concrete, thermal properties of concrete, and effects of neutron irradiation on concrete properties. Separate abstracts were prepared for all 21 papers. (DLC)

For abstracts of individual papers see: 3378–3396, 4512, and 4573.

3378 EXPERIMENTAL APPROACH TO TRIAXIAL CREEP AT ELEVATED TEMPERATURES. Jundi, N.; Kennedy, T. W.; Perry, E. S.; Thompson, J. N. (Univ. of Texas, Austin). pp 641-658 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

An extensive study of the time-dependent deformation of concrete specimens subjected to various stress conditions and elevated temperatures was begun. Experimental aspects of this study, preliminary investigations, preparation of specimens, and instrumentation as well as the testing procedure are discussed. The following conclusions were made: (1) the vibrating-wire strain gage was stable under long-term testing, but it had a higher coefficient of thermal expansion than the concrete utilized in this program; (2) the specimen configuration and its steel end caps probably had a direct influence on the resulting deformations; (3) specimen sealing techniques employed were not always successful, some solder joints being defective; and (4) the pressure loss, due to the frictional characteristics of the hydraulic rams, was recognized and compensated for in part in the analysis of the data. (DLC)

3379 EFFECTS OF TEMPERATURE AND MOISTURE ON TRIAXIAL CREEP. York, G. P.; Kennedy, T. W.; Perry, E. S.; Thompson, J. N. (Univ. of Texas, Austin). pp 659-699 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Results are presented of a research program on the creep behavior of concrete under multiaxial states of stress and elevated temperatures. 6 × 16-inch cylindrical samples were used. (6 references, 12 figures, 7 tables) (auth)

3380 PREDICTION OF MULTIAXIAL CREEP FROM UNIAXIAL CREEP TESTS. Chuang, J. W.; Kennedy, T. W.; Perry, E. S.; Thompson, J. N. (Univ. of Texas, Austin). pp 701-734 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

A study was conducted to investigate creep strains in concrete subjected to multiaxial compressive stresses under various moisture and temperature conditions and to develop equations for predicting creep strains for multiaxial stresses from uniaxial tests. Tests were performed on 6 × 16-inch concrete cylinders with embedded vibrating wire gages. Conclusions are summarized: (1) Unit creep of concrete under constant temperature and with a given curing history is a function of concrete age at loading, time after loading, and stress levels. When the applied stress is less than the creep proportional limit, unit creep of concrete is independent of stress levels. (2) The creep proportional limit varied with moisture conditions and testing temperatures. Generally, as-cast specimens at room temperature have higher proportional limits, and air-dried specimens tested at elevated temperature have lower proportional limits. (3) The creep Poisson's ratio for as-cast specimens was higher than that for air-dried specimens. At 75°F, the average creep Poisson's ratios were 0.150 for as-cast specimens and 0.108 for air-dried specimens; 150°F, the ratio was 0.149 and 0.140, respectively. (4) The creep prediction technique was satisfactory when stress levels were less than the creep proportional limit. For stress levels higher than the creep proportional limit, the measured creep strains were higher than the predicted values. (14 references, 13 figures, 4 tables) (DLC)

3381 EXPERIMENTAL STUDY OF MULTIAXIAL CREEP IN CONCRETE. McDonald, J. E. (Army Waterways Experiment Station, Vicksburg, MS). pp 735-768 of Concrete for Nuclear Re-

actors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol.2).

A study was conducted on the time-dependent deformation behavior of concrete in the presence of varying temperature, moisture, and loading conditions similar to those encountered in a prestressed concrete reactor vessel (PCRV). This study was concerned with one concrete strength, three aggregate types, one cement, two moisture conditions, two testing temperatures, and four loading conditions. Creep results are presented and summarized generally. (22 figures, 3 tables) (auth)

3382 BEHAVIOR OF CONCRETE UNDER VARIABLE TEMPERATURE AND LOADING. Mukaddam, M. A.; Bresler, B. (American Univ., Beirut). pp 771-797 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

A mathematical model is developed that defines deformation of concrete, taking into account temperature history, load history, aging of concrete, and influence of temperature on creep of concrete. Previously published experimental data on sealed specimens is used to derive constitutive relations that account for effect of temperature on creep. These expressions are applied to concrete under variable uniaxial compression and variable temperature. (27 references, 8 figures) (auth)

3383 BEHAVIOR OF FLEXURALLY RESTRAINED PRESTRESSED CONCRETE BEAMS UNDER TEMPERATURE GRADIENT. Aoyagi, Y.; Ohnuma, H.; Kawasaki, M. (Central Research Inst., Chiba, Japan). pp 799-821 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol.2).

Results are presented of experimental studies on the effects of creep at elevated temperatures on the relaxation of stress and on the amounts of deformation in flexurally restrained prestressed concrete beams. (18 figures) (auth)

3384 INVESTIGATION OF THE TIME-DEPENDENT BEHAVIOR OF PRESTRESSED CONCRETE PRESSURE VESSELS. Whitman, G. D.; Callahan, J. P.; Corum, J. M. (Oak Ridge National Lab., TN). pp 823-846 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

A thermal cylinder model was designed for the purpose of providing a structure that simulates a portion of the barrel of a cylindrical vessel. Provision is made for applying internal pressure and a temperature profile simulating the thermal conditions in an operating PCRV. All surfaces are sealed to prevent moisture loss and the model will be instrumented to measure stress, strain, moisture level and temperature at selected locations. (6 references, 7 figures) (auth)

3385 INFLUENCE FACTORS OF ELEVATED TEMPERATURES ON THERMAL PROPERTIES AND INELASTIC BEHAVIOR OF CONCRETE. Abe, H.; Kawahara, T.; Ito, T.; Haraguchi, A. (Central Research Inst., Chiba, Japan). pp 847-870 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol.2).

Results are presented of an investigation on the determination of proportion, selection of material, the concept of design constants in analyzing thermal stress, and factors of elevated temperature affecting thermal and mechanical properties of concrete. (15 figures, 4 tables) (auth)

3386 MOISTURE CONDITION OF CONCRETE. Schimmelwitz, P.; Hundt, J. (Bundesanstalt fuer Materialpruefung, Berlin). pp 873-882 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

For international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol.2).

From the radiation shielding standpoint, the highest possible moisture content in concrete is desirable. An investigation on the moisture distribution in concrete under the influence of increased temperatures experienced in reactors is reported. (auth)

3387 SHRINKAGE, MOISTURE, AND PORE PRESSURES IN HEATED CONCRETE. England, G. L.; Ross, A. D. (King's Coll., London). pp 883-907 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Some effects related to moisture in concrete at elevated and nonuniform temperatures are described. Experiments staged to record shrinkage, moisture content, and pore pressure have indicated that permeability of concrete plays an important part in the changes that occur. Moisture movement, which is encouraged by high vapor pressures in regions of high temperatures, is resisted in cooler regions and this causes zones of higher than normal water content to build up. In consequence of the low permeability, pore pressures are slow to dissipate. Shrinkage which is moisture-dependent is affected by the changing moisture distribution with time. Experiments incorporating moisture paths of up to 10 ft in length and maximum temperatures of 150°C, revealed that pore pressures close to the values estimated theoretically exist during the early stages of heating, and that these take several months to dissipate appreciably into a large mass of concrete. Some experimental results are presented. (11 references, 15 figures) (auth)

3388 WATER MIGRATION IN CONCRETE UNDER A SUSTAINED TEMPERATURE GRADIENT. Poitevin, P. (Centre d'Etudes Scientifiques et Techniques, Grenoble, France). pp 909-929 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Shrinkage, creep strains, thermal conductivity, and deformation behavior under load are affected by the moisture content of a concrete structure. A study of moisture migration under a sustained temperature gradient along the axis of 300-mm-long and 80-mm-diameter concrete cylinders was undertaken to obtain some information on the possible moisture movement in the 5.50-m-thick cylindrical wall of BUGEY-I P.C.R.V. (13 figures, 2 tables) (auth)

3389 EXPERIMENTAL STUDY OF MOISTURE MIGRATION IN CONCRETE. McDonald, J. E. (Army Waterways Experiment Station, Vicksburg, MS). pp 957-989 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 970). See CONF-701007-(Vol.2).

In an effort to obtain information regarding the nature of moisture movement and rate of moisture loss in a prestressed concrete reactor vessel (PCRV), an experimental study of moisture migration in a pie-shaped specimen representing the flow path through a cylindrical wall of a PCRV was initiated. After casting of the test specimen, temperature distribution, shrinkage, and moisture distribution were monitored for approximately 17 months. After this initial testing, a temperature gradient of 80 F (44°C) was applied to the specimen, and the above-mentioned measurements are being continued for an additional test period of one year. Based on the results obtained to date, it appears that there have been no significant changes in the specimen's moisture content. (24 figures) (auth)

3390 EFFECT OF TEMPERATURE ON THE DRYING OF CONCRETE. Yuan, R. L. (Univ. of Texas, Arlington); Hilsdorf, H. K.; Kesler, C. E. pp 991-1017 of Concrete for Nuclear Reactors. Vol II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Drying of concrete is influenced by the properties of the cement paste matrix and environmental conditions. An experimental investigation was undertaken to check the applicability of the diffusion theory to the drying of concrete. The variables were the water–cement ratio, temperature, and relative humidity. Good agreement between theory and experiments was obtained. Also desorption isotherms for four different mortars were determined. (15 references, 14 figures) (auth)

3391 PRELIMINARY STUDY ON THERMAL MOISTURE TRANSFER IN CONCRETE. Pihlajavaara, S. E.; Tiusanen, K. (State Inst. for Technical Research, Otaniemi, Finland). pp 1019-1033 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007–(Vol.2).

A brief preliminary study was made of moisture transfer due to temperature differences in concrete made in this laboratory. An introduction to the theory of thermal moisture transfer in capillary porous colloidal solids, a simple examination of the significance of the phenomenon in moist concrete under tempera-

ture gradient, as well as the results of a preliminary test series on cement stone are presented. (4 figures, 9 references) (auth)

3392 THERMOS-CALORIMETER FOR CONCRETE IN EVALUATION OF CEMENTS AS TO HEAT EVOLUTION. Vuorinen, J. (Imatra Power Co., Helsinki). pp 1037-1046 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

For the evaluation of cements with regard to the temperature effects in concrete, both the early heat evolution (up to 3 or 7 days) and the strength development (at 28 or 90 days) should be observed with reference to the same concrete composition. The heat produced by cement hydration can be measured in a concrete sample using a thermos calorimeter, the design, calibration, and operation of which is described, together with some results of laboratory tests. (auth)

3393 THERMAL CONDUCTIVITY AND THERMAL EXPANSION COEFFICIENTS OF CONCRETE AS A FUNCTION OF TEMPERATURE AND HUMIDITY. Marechal, J. C. (Centre Experimental de Recherches et d'Etudes du Batiment et des Travaux Publics, Paris). pp 1047-1057 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Thermal conductivity and thermal expansion coefficients were measured on various concretes according to temperature and loss of water up to 500°C. Results are discussed in relation to the other properties. (4 figures) (auth)

3394 SOME PECULIARITIES AND RESULTS OF INVESTIGATIONS OF THERMAL CONDUCTIVITY AND DIFFUSIVITY OF HEAVY CONCRETES. Desov, A. E. (Research Inst. of Concrete and Reinforced Concrete, Gosstroy, USSR); Jankelev, L. F. pp 1059-1067 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Attempts were made to overcome the difficulties in studying thermotechnical properties of heavy concretes. To exclude the influence of thermal contact resistance it is recommended to test specimens of different thickness, placing the sample in intimate contact with the thermocouple, and using lubrication of the surface. Knowing the thermal conductivity of the lubrication and air, one can calculate the real conductivity of a specimen. The same purpose is attained by embedding the thermocouples in the specimen and packing the concrete mixture. The same thermocouples, heated by high-frequency current, serve as linear heat sources for determining the thermal conductivity. This property was also investigated by the method of steady-state thermal conductivity. The temperature, taken in investigations by both methods, somewhat exceeded 200°C. (auth)

3395 EFFECTS OF NEUTRON RADIATION ON SPECIAL CONCRETES AND THEIR COMPONENTS. Elleuch, L. F.; Dubois, F.; Rappeneau, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 1070-1108 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

The various types of concrete used in the construction of nuclear works, and especially heat-insulating concretes, were subjected to increasing irradiation doses and temperatures. The effects of neutron irradiation on special concretes, cements, and granulates were studied on samples irradiated in the Triton pile. After irradiation the dimensional changes, modifications of mechanical properties (elastic modulus and breaking stress) and changes in weight of the samples were determined. A brief description of the irradiation devices and the measurement methods is followed by a discussion of the results obtained on concretes based on serpentine granulates bound with an aluminous cement, irradiated at ~250°C and at doses up to 10^{20} n.cm^{-2} (>1 MeV). Appreciable changes in the mechanical properties and in the dimensions were observed. (10 references, 14 figures) (auth)

3396 STUDIES ON BEHAVIOR OF CONCRETES UNDER IRRADIATION. Granata, S.; Montagnini, A. (AGIP Nucleare SpA, Milan). pp 1163-1172 of Concrete for Nuclear Reactors. Vol II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

A report of an experiment on the effects of irradiation on standard and BHT (Portland 730 cement and barytic aggregate) mortars is presented. Samples with similar thermal histories were used as a control to separate thermal and radiation effects. At the end of the experiments all thermal history samples were in good condition, the lower temperature irradiated specimens were partially cracked and damaged, and the samples under higher temperatures and neutron fluxes were severely cracked and damaged. (auth)

3397 CONCRETE FOR NUCLEAR REACTORS. Volume III. Conference Held at Berlin, October 5-9, 1970. Kesler, C. E. (ed.). Special Publication SP-34. Detroit; American Concrete Institute (1972). 570p. (CONF-701007-(Vol.3)).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970).

Twenty-two papers are presented under the following headings: special radiation shielding concretes, chemical compatibility problems in grouting of prestressing cables, air permeability of concrete, apparatus and instrumentation for measurements of concrete properties, model test and measurements on full-scale vessels; improvement of concrete properties (future research and development, information exchange), and bibliography. Keyword and author indexes are included. Separate abstracts were prepared for all 22 papers. (DLC)

For abstracts of individual papers see: 3398-3411, 4513-4515, 4525, 4526, and 4637-4639.

3398 IRON-SERPENTINE CONCRETE. Davis, H. S. (Douglas United Nuclear, Inc., Richland, WA). pp 1195-1224 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Data are presented on the physical and nuclear shielding properties of two types of iron-serpentine concrete. Specimens were tested under standard conditions and after being heated at elevated temperatures up to about 320°C. These high-density concretes were designed for use in the construction of nuclear reactor shields which will operate at elevated temperatures. Densities of 220 and 265 lb/ft^3 were obtained by using steel aggregates in combination with serpentine. The latter aggregate retains most of its chemically bound water at temperatures as high as 450°C, and thus is a reliable source of hydrogen for attentuating neutrons when shield temperatures are high. Only certain types of serpentine rock are suitable for making shielding concrete. Thus, care must be exercised in order to obtain rock which is high in bound water content, structurally strong, and relatively free of fiber. (5 figures, 12 tables) (auth)

3399 SERPENTINE CONCRETE FOR CZECHOSLOVAKIAN A-2 REACTOR SHIELDING. Honig, A. (Brno Technical Univ.); Vesely, F.; Samalikova, M.; Stoces, B.; Havranek, M. pp 1225-1241 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Results are presented of geological prospecting and of testing physical and mechanical properties of serpentinite and ordinary concretes. Results (such as cube compression strength, tensile strength under bending, volume stability, thermal expansion, and bound crystallic water content) are compared for serpentinite and ordinary concretes. Shielding properties of ordinary and serpentinite concrete are compared on the basis of experimental measurements on the reactor, as well as on the basis of theoretical calculations using the S_N method. (16 references, 4 figures) (auth)

3400 PROPERTIES OF MAGNETITE AND SERPENTINE CONCRETE AT ELEVATED TEMPERATURES FOR NUCLEAR REACTOR SHIELDING. Ohgishi, S. (Nagoya Inst. of Tech., Tokyo); Miyasaka, S.; Chida, J. pp 1243-1253 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A general rule for reactor biological shielding materials is that an ordinary concrete or high-density concrete using an aggregate such as magnetite, limonite, etc., is the most reasonable for a thermal neutron reactor. These concretes include much crystal water such as serpentine, ophicalcite aggregate, etc. This paper consists of two parts: first, an experiment on magnetite aggregate concrete and ordinary concrete at elevated temperatures from 20 to 600°C is reported, and second an experiment on serpentine aggregate concrete and ophicalcite aggregate concrete subjected to different degrees of heating is reported. (12 figures) (auth)

3401 GROUTING MORTAR FABRICATION AND PROPERTIES, GROUTING PROCEDURES, AND GROUTING MORTAR INTERACTION WITH PRESTRESSING CABLES. Muehe, L. (Philipp Holzman AG, Frankfurt am Main). pp 1257-1263 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

The interaction of pressure grout and the wires in post-tensioning tendons is investigated both during and after pressure grouting. Basic tests on a minimum spacing between the wires in one bundle, studies on the procedure of grout flow in the longitudinal direction and finally a model test for the grout flow in the cross direction of a prestressed duct are reported. (auth)

3402 CORROSION PROBLEMS OF THE PRESTRESSING CABLE STEEL FOR NUCLEAR PRESSURE VESSELS: ITS PROTECTION AND PRESERVATION. Scotto, F. (ENEL, Rome). pp 1265-1284 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

The state of the art of corrosion protection for prestressing tendons in reactor pressure vessels is presented. Proposals for improving grouting and other corrosion protection techniques are given. The two methods of protection, conventional (mortar grouting) and nonconventional, are compared and contrasted. (auth)

3403 TO GROUT OR NOT TO GROUT. Jaeger, T. (Bundesanstalt fuer Materialspruefung, Berlin). pp 1285-1287 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

The state of the art of corrosion protection of prestressing tendons by grouting is presented. (auth)

3404 PROOF OF LEAKAGE RATE OF A CONCRETE REACTOR BUILDING. Buss, W. (Gutehoffnungshuette Sterkrade AG, Ogerhausen, Ger.). pp 1291-1320 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Cracks in concrete, porosity, and lack of bond with fittings cause air leakage in concrete. Results are presented of tests to determine the leakage rate of a concrete reactor building without a leakproof lining. Cracked concrete proved unsuitable for meeting safety requirements of leakage. (7 references, 12 figures) (auth)

3405 DESIGN OF AN APPARATUS FOR SHORT-TIME TESTING OF CONCRETE UNDER TRIAXIAL LOAD. Shickert, G. (Bundesanstalt fuer Materialpruefung, Berlin). pp 1355-1376 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Principles for the construction of a testing apparatus to be used for investigations on multiaxial strength of concrete are explained. The primary tests will be done with 20-cm cubes submitted to compressive and tensile loads applied to each axis in the following combinations: compression/compression/compression, compression/compression/tension, compression/tension/tension. Compressive loads are to amount up to 8 MN and tensile loads up to 0.4 MN corresponding to a maximum compressive stress of 2000 daN/cm^2 (2000 bar) and a maximum tensile stress of 100 daN/cm^2 (100 bar). The testing method characterized by deformable "platens" consisting of a multitude of individual stamps is described. This new method will be used in addition to rigid platens with multilayer insertions of laminated materials. (23 references) (auth)

3406 INSTRUMENTATION AND TECHNIQUES FOR STUDY OF CONCRETE PROPERTIES AT ELEVATED TEMPERATURES. Bertero, V. V.; Bresler, B.; Polivka, M. (Univ. of California, Berkeley). pp 1377-1419 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A report is presented on the instrumentation developed and the techniques implemented in carrying out a long-term study of load-deformation characteristics of concrete subjected to varying thermal exposures. (auth)

3407 RADIOMETRIC TESTING OF DENSITY OF CONCRETE FOR RADIATION SHIELDING. Honig, A.; Pospisilova, L. (Brno Technical Univ.). pp 1439-1468 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

The biological shields of nuclear reactors are partly thick-walled concrete constructions which do not require special attention, as far as their strength is concerned. Their density, however, is very important, since the attenuation of photons is directly proportional to concrete density. The ultrasonic method enables one to determine the nonhomogeneity of concrete, but its subsequent improvement is problematic. The expenses connected with the injection operations are not proportional to the improvement reached. The radiometric method makes possible the immediate determination of imperfectly compacted concrete. Immediate improvement is possible before the hardening of concrete. Some types of radiometric probes suitable for density measurement, as well as the results of the reactor shield construction of a nuclear power station, an experimental nuclear reactor, and a biological shield of a betatron are described. The RILEM program for comparison of commercial portable gages for radiometric determination of building materials density and moisture is discussed. (16 figures) (auth)

3408 HIGH-STRENGTH, HIGH-DENSITY CONCRETE. Mather, K. pp 1587-1596 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Any sound concrete, in sections of sufficient thickness, can be used to construct a satisfactory biological shield. When space permits, conventional concrete is the most economical, satisfactory shield against radiation. However, when space is a consideration, high-density concrete can be used for shielding. Most high-density concrete for shielding has been made with naturally occurring iron ores, titaniferous iron ores, "hydrous iron ores," and barite. Although structural strength is an important factor in high density concrete, workability and density have been the major factors previously studied. This investigation showed that high-strength concrete can be made using materials that provide high density, and that high-density concrete can be made using proportions that ensure high strength. When high strength and high density are both desired, they can be attained by a direct combination of the standard practices developed for attaining each condition separately. Concrete made as part of this study using magnetite aggregate or ilmenite aggregate having a hardened unit weight of about 230 lb/ft^3 had a compressive strength of 9000 psi at 7 days and 11,000 psi at 28 days. (auth)

3409 GENERAL APPROACH TO CONCRETE TECHNOLOGY RESEARCH. De Pra, M. (Tecnica Tecnologia Calcestruzzo srl, Milan). pp 1621-1624 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A criticism of the present philosophy in concrete research is presented. (auth)

3410 SUMMARY: CONCRETE FOR THE CONTAINMENT AND SHIELDING OF NUCLEAR REACTORS. Kaplan, M. F. (Univ. of Cape Town). pp 1625-1636 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol. 3).

A general summary of the International Conference on Concrete for Nuclear Reactors is presented. (auth)

3411 ANNOTATED BIBLIOGRAPHY ON CONCRETE FOR RADIATION SHIELDING. Polivka, M. (Univ. of California, Berkeley). pp 1639-1722 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F. R. Germany (5 Oct 1970). See CONF-701007-(Vol. 3).

The purpose of this bibliography is to present to those in the field of concrete and concrete materials and to those connected with the design and construction of radiation shields selected literature pertaining to the types and properties of concretes used in radiation shields. The references are primarily published papers. Only the final reports have been listed and references to progress reports are omitted. A number of references and their annotations were obtained from members of the Subcommittee on Concrete for Radiation Shielding of ASTM Committee C-9, and

from Miss Ethel V. Lyon, librarian of the Portland Cement Association. No attempt was made to include all available references. Many of the papers published during the last few years were omitted since much of the same basic information was covered in earlier papers. (365 references) (auth)

3412 THERMAL EXPANSION OF GLASSY CARBON. Gaal, P. S. (Westinghouse Electric Corp., Pittsburgh). High Temp.-High Pressures; 4: No. 5, 551-557(1972).

The linear thermal expansion behavior of several grades of glassy carbon was investigated from 23 to 2300°C. The expansion of all stocks combined may be described by the polynomial: $(L_T - L_{23}/L_{23}) \times 100 = -6.5261 \times 10^{-3} + 2.9498 \times 10^{-4}T + 7.1974 \times 10^{-8}T^2(\%)$, where T is in °C, yielding a mean coefficient of $4.5 \times 10^{-6}K^{-1}$ for the range 23-2300°C. Total of 44 tests were performed, including a 22-cycle replication run. Definite trends of the coefficient increasing with increasing processing temperatures were established and traces of graphitization were detected. (auth)

3413 THERMAL CONDUCTIVITY OF PYROLYTICALLY DEPOSITED CARBON BETWEEN 25 AND 1100°C AFTER FAST-NEUTRON IRRADIATION. Gilchrist, K. E. (United Kingdom Atomic Energy Authority, Springfields, Eng.). High Temp.-High Pressures; 4: No. 5, 497-501(1972).

Experiments were carried out to measure the thermal diffusivity and conductivity from 25 to 1100°C on pyrolytically deposited carbon discs. Pyrolytic carbons are being examined as coatings for high-temperature gas-cooled-reactor fuel particles. Measurements were performed normal to the deposition plane, using a laser flash technique, on pyrocarbon coatings deposited from methane and acetylene. Thermal conductivity values in the range 3 to 11 $Wm^{-1}K^{-1}$ with little or no temperature dependence were obtained for unirradiated pyrocarbon. There was no significant effect on the thermal conductivity of methane or acetylene-derived coatings due to fast-neutron irradiation up to 5.7×10^{21}n cm^{-2} (NIDIDO). (auth)

3414 MAGNETIC ORDERING OF NEODYMIUM MONOPNICTIDES DETERMINED BY NEUTRON DIFFRACTION. Schobinger Papamantellos, P. (Eidgenoessische Technische Hochschule, Zurich); Fischer, P.; Vogt, O.; Kaldis, E. J. Phys., C (London); 6: No. 4, 725-737(28 Feb 1973).

The magnetic structures and ordered moments of NdN, NdP, NdAs, and NdSb with NaCl structure were determined by means of line-profile analysis of neutron diffraction powder patterns. NdN orders ferromagnetically at 4.2°K, which is characteristic of most 4f nitrides. The other neodymium monopnictides in contrast to the type II magnetic structures of heavy rare earths show fcc (bct) type I antiferromagnetism at low temperatures (magnetic moments aligned parallel to the [001] direction), like similar 5f compounds. Except for NdBi and NdSb, the ordered magnetic moments are reduced considerably below the free-ion value because of crystal-field effects and due to comparably weaker magnetic exchange interactions. The experimental and calculated neutron magnetic form factors of Nd^{3+} (dipole and $M_J = J$ approximations) are in reasonable agreement. The measured powder intensities do not show conclusive evidence for anisotropy of the form factor related to the asymmetry of the magnetization distribution. The observed magnetic structures are discussed in the context of molecular field theory, and exchange constants were determined. The neutron scattering amplitude of neodymium was refined to $b_{Nd} = 0.75(1) \times 10^{-12}$ cm. (auth)

3415 CRITICAL PHENOMENA AND NEUTRON SCATTERING. I. Parette, G. (CEN de Saclay, Gif-sur-Yvette, France). Ann. Phys. (Paris); 7: No. 4, 299-312(Jul 1972).

Expressions for the magnetic scattering cross section of thermal neutrons near to the critical temperature are presented. The first theories concerning the relaxation of critical magnetic fluctuations (conventional theories) are presented together with the Halperin and Hohenberg theory which is based upon a generalization of the scaling-law concept (which has already been used to study static critical phenomena). It is shown that conventional theories do not enable the neutron scattering results to be interpreted. An experimental verification of the scaling-law hypotheses is presented. Emphasis is given to the difficulty encountered in finding magnetic substances which can be represented by theoretical systems to which the Halperin and Hohenberg theory can be applied. (FR)

3416 EPR AND THERMOLUMINESCENCE OF CALCIUM TUNGSTATE IRRADIATED BY γ RAYS. Vakhidov, Sh. A.; Gasanov, E. M.; Gabrielyan, V. T. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 68-70(1972). (In Russian).

Preliminary results are given of an investigation of EPR centers of $CaWO_4$ (scheelite) single crystals and their luminescence curves. Experiments were conducted both with nonactivated $CaWO_4$ and with $CaWO_4 : Nd^{3+}$. Samples were irradiated by ^{60}Co-emitted γ rays at 5000 and 270 R/sec and at 77 and 350°K. EPR spectra of crystals irradiated at 77°K were taken at 77°K. The thermoluminescence of the crystals was observed in the temperature range −175 to −70°C with a heating rate of 8°C/min. (KSW)

3417 FORMATION OF INTEGRATED CIRCUITS. (To Texas Instruments Ltd.). British Patent 1,304,866. 31 Jan 1973. Filed date 15 Sep 1970. 9p.

A method is described for fabricating integrated circuits having circuit elements formed in electrically isolated regions of a semiconductor body. Surface areas of the semiconductor body corresponding to the peripheries of these regions are doped with impurities of opposite conductivity type, and while the body is heated the surface doped regions are bombarded with low-mass ions selected from protons, α particles, or low-mass inert gases, in order to enhance the rate of diffusion of the impurity into the semiconductor material and to form lateral boundaries of the isolated regions. A description is given of the method as employed for electrically isolating selected regions of an epitaxial layer in an integrated circuit structure having a substrate of one type of conductivity and an epitaxial layer of opposite type conductivity. The electrically isolated region of the epitaxial layer may form the collector region of a transistor, the base and emitter regions being formed within the collector region; here the substrate may be p-type Si, the epitaxial layer n-type Si, and the emitter region a P or As doped region. (UK)

3418 CHANGE IN ELECTRON DENSITY IN GALLIUM ARSENIDE DURING IRRADIATION WITH FAST NEUTRONS. Stel'makh, V. F.; Tkachev, V. D. (Belorussian State Univ., Minsk). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 47-51(1973). (In Russian).

The effects on GaAs crystals of irradiation with fast neutrons at about 340°K were investigated. The extent of radiation damage to relatively perfect and pure crystals depended on the integral radiation flux up to some critical flux as determined by the original concentration of current carriers. A decrease in the rate of elimination of carriers in the crystals with increased concentration of residual defects was caused by the participation of the latter in the kinetics of defect formation. The initial rates of carrier removal in crystals were determined with crystals produced under different growth conditions. (tr-auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

3419 (CONF-720529-) PROCEEDINGS OF THE 13TH ANNUAL MEETING OF THE INSTITUTE OF NUCLEAR MATERIALS MANAGEMENT, INC., BOSTON, MASSACHUSETTS, MAY 31–JUNE 2, 1972. (Institute of Nuclear Materials Management, Columbus, Ohio). Sep 1972. 448p. Kansas State Univ., Manhattan $7.50.

Thirty-two papers were presented at the conference. A separate abstract was prepared for each of 25 papers. Seven were previously abstracted in NSA. For abstracts of these see CONF-720529 in the Report Number Index. (LCL)

For abstracts of individual papers see: 3420 through 3444.

3420 (CONF-720529–, pp 1-26) GETTING ON WITH UPGRADING OF SAFEGUARDS IN LICENSE-EXEMPT OPERATIONS. Crowson, D. L. (Atomic Energy Commission, Washington, DC). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Efforts aimed at developing a comprehensive safeguards system applicable to all facilities handling nuclear materials are described. Transportation safeguards, international safeguards developments, equipment and methods used at LASL for safeguarding the Pu recovery facility, field studies to obtain data on the performance of safeguards systems in AEC production facilities, and the use of these field data to develop safeguards criteria to assure that all AEC license exempt facilities can meet AEC safeguards standards are reviewed. (LCL)

3421 (CONF-720529–, pp 27-28) NUCLEAR CONTROLLERSHIP. Thornton, C. D. W. (Atomic Energy Commission, Washington, DC). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Aspects of improved safeguards are itemized and include: development of advanced techniques for automating nuclear materials handling, measurements, verification, and data processing; use of dynamically responsive mathematical models to devise optimal systems; improved measuring equipment and methods; and development of valid safeguards standards supported by meaningful inspections and systems tests. (LCL)

3422 (CONF-720529–, pp 29-34) INTERNATIONAL SAFEGUARDS UPDATED. Mahy, J. F. Jr. (Atomic Energy Commission, Washington, DC). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Events in international safeguards during the year preceding May 1972 are reviewed and include negotiation of individual agreements between nations and studies of the procedural details and technical requirements necessary to implement the Nonproliferation Treaty (NPT) safeguards systems. The status of ratification of the NPT is described. Activities related to US involvement are emphasized and include US implementation of IAEA safeguards, contributions to international studies of IAEA safeguards, US research related to international safeguards, and USAEC programs for training safeguards personnel from many countries. (LCL)

3423 (CONF-720529–, pp 35-79) MATERIALS LICENSING OF FUEL CYCLE PLANTS: PROBLEMS AND PROGRAM GOALS. Smiley, S. H. (Directorate of Licensing, Washington, DC), Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The AEC regulatory functions related to materials licensing of fuel cycle plants performed by the Fuels and Management Section of the Directorate of Licensing are discussed in detail. Fuels and Management also has the licensing responsibility for uses of radioisotopes, export licensing, and for administrating the AEC's Agreement State program, each of which is described. The major responsibility is the comprehensive safety and safeguards evaluations conducted on license applications. This includes evaluating the safety of shipping container designs, of fuel cycle plant design and construction, and of waste management at fuel cycle plants. Programs for meeting this responsibility now and in the future are discussed. (LCL)

3424 (CONF-720529–, pp 80-85) INDUSTRIAL VIEW OF SAFEGUARDS. VanHoomissen, J. E. (General Electric Co., San Jose, CA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The economic factors, political and social environment, and legal requirements which motivate industry to do a good job in the management of nuclear materials and to safeguard against diversion are discussed. (LCL)

3425 (CONF-720529–, pp 86-90) SAFEGUARDS ISSUE. Lumb, R. F. (Nuclear Surveillance and Auditing Corp., Rockville, MD). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The background of a current controversy between the nuclear industry and the USAEC regulatory arm over requirements for safeguarding special nuclear materials is reviewed and explained. It is felt that with changes since 1966 in the status of nuclear materials used by private industry, i.e., that the nuclear materials now represent an investment of private capital instead of being leased from the AEC, private industry now has a great economic incentive to account for all nuclear materials and must extend normal business practices to the protection of capital assets represented by the nuclear material. At the same time, the regulatory program has an obligation to better define and fix its safeguards goals and criteria so that all companies involved will be treated equally and will not suffer economic hardships due to changes in safeguards regulations. (LCL)

3426 (CONF-720529–, pp 91-109) HOW ONE UTILITY'S FUEL QA PROGRAM COMPLEMENTS THE INDUSTRY SAFEGUARDS EFFORT. Daebeler, G. F. (Philadelphia Electric Co.). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Based on a comprehensive fuel cycle economic analysis, the Philadelphia Electric Co. decided to assume the financial and administrative responsibilities associated with fuel procurement for its Peach Bottom reactors. The quality assurance and accountability program developed to meet these responsibilities, the equipment and methods used, and how these activities have complemented the nuclear industry safeguards efforts are discussed. (LCL)

3427 (CONF-720529–, pp 110-114) ATOMIC INDUSTRIAL FORUM'S NUCLEAR MATERIALS SAFEGUARD COMMITTEE ORGANIZATION AND ACTIVITIES. Osborn, K. R. (Allied Chemical Corp., Morristown, NJ). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The history, development, and activities of the Atomic Industrial Forum's Committee on Nuclear Safeguards and Inspections, its past difficulties in working with the regulatory staff of the USAEC, and current progress in contributing to the AEC's development of methods criteria, guidelines, and regulations for effective nuclear materials safeguards which are compatible with commercial practices and with IAEA recommendations for complying with the NPT are described. (LCL)

3428 (CONF-720529–, pp 115-119) SAFEGUARDS: THE IMPACT ON INDUSTRY. Haymon, D. J. (Westinghouse Electric Corp., Pittsburgh). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Past difficulties in establishing a completely viable and effective safeguards system founded on reason and logic are reviewed from the point of view of American industry. Industry proposals for a joint industry-AEC working group to resolve these difficulties are discussed. Safeguarding practices in foreign countries are referred to. Future cooperative efforts between all segments of the nuclear industry and the regulatory body to achieve the safeguards goals are hoped for. (LCL)

3429 (CONF-720529–, pp 120-135) NUCLEAR FUEL MANAGEMENT UTILITY INVOLVEMENT: HOW MUCH? An Assessment of Objectives. Walke, G. J. (Consumers Power Co., Jackson, MI). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

In order to answer the basic question, should a utility get involved in the details of nuclear fuel management, these details are described from the early stages of planning for fuel procurement through in-core operations to fuel removal. The interrelationship of regulatory, reliability, and economic aspects of nuclear fuel management and the effects of this interrelationship on the decision for utility involvement are stressed. It is concluded that a utility should get intimately involved in all aspects of nuclear fuel management and staff itself with experts capable of determining that the fuel the utility buys and operates does not jeopardize nuclear power plant operations. (LCL)

3430 (CONF-720529–, pp 136-145) WHAT THE AUDITOR LOOKS FOR IN EVALUATING INTERNAL CONTROL OVER NUCLEAR FUEL. Antonello, J. Jr. (Arthur Andersen and Co., Chicago). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The four basic characteristics which an auditor looks for when evaluating a system of internal control and which are applicable to the safeguarding of nuclear materials are: the organization of separated functional responsibilities; sound practices to be followed in performance of the functions of each organizational department; a system of authorization and record keeping to provide accounting control; and personnel qualified to fulfill the specified responsibilities. The application of these characteristics to safeguarding materials in a nuclear power plant is discussed. (LCL)

3431 (CONF-720529–, pp 155-160) BALANCED STAGGERED NESTED DESIGN FOR THE ESTIMATION OF MEASUREMENT ERRORS IN PLUTONIUM DETERMINATIONS. Hagie, L. T. (General Electric Co., Pleasanton, CA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The determination of random error components in a measurement process is frequently accomplished by a statistical testing procedure known as a nested design. Where analytical costs are a significant consideration, the standard nested design may require excessive sampling at the lowest levels and too little sampling at the highest levels. One method of solving this problem is by selective "pruning" of the lower levels of the design to retain the symmetrical balance in the design, but to re-allocate the samples in such a way that improved estimates of measurement errors for the higher levels may be obtained by sacrificing some of the precision available at the lower levels. A four-level balanced staggered nested design is described. The test was used to evaluate the measurement error of plutonium determinations in a mixed oxide. (auth)

3432 (CONF-720529–, pp 161-169) HOW EXACT ARE THE "EXACT" VARIANCES ON URANIUM? Post, R. I. (General Electric Co., San Jose, CA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The problem of determining uncertainties in measured quantities of nuclear materials leads directly to the question of estimating the variance of a product of two or more random variables. For example, the total amount of uranium in a container is the product of a bulk measurement (weight or volume) and a concentration factor. The unbiased estimator of the variance is derived and compared to estimators based on the Taylor series approximation of the true variance and on direct substitution into the variance formula. The results of the analyses indicate that unless the coefficients of variation of both variables are at least 0.5, the estimator based on the Taylor series approximation is a reasonable estimator of the true variance and a better estimator than the one based on the "exact" variance. In the event that both variables have coefficients of variation of at least 0.5, then the unbiased estimator should be used. Similar results apply for products of three independent variables. (LCL)

3433 (CONF-720529–, pp 170-196) PORTABLE DRY CALORIMETER FOR THE NONDESTRUCTIVE ASSAY OF MIXED OXIDE FUEL RODS. Beyer, N. A.; Lewis, R. N.; Perry, R. B. (Argonne National Lab., IL). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The design and operating characteristics of a calorimeter which was built for the nondestructive measurement of the plutonium in the ZPPR (Zero Power Plutonium Reactor) mixed-oxide fuel rods are described. Design details of two models of this instrument are presented together with an evaluation of operating characteristics based upon the experience of using the instruments to nondestructively assay a fuel inventory. The inventory measurement program is discussed and the results are compared with results from chemical analyses and other nondestructive measurements. (LCL)

3434 (CONF-720529–, pp 197-203) OPERATING PERFORMANCE AND MATERIAL BALANCE RAMIFICATIONS OF PLUTONIUM NONDESTRUCTIVE NUCLEAR ASSAY INSTRUMENTATION. Bishop, D. M. (General Electric Co., San Jose, CA); Martin, G. C.; Simpson, J. L.; Wadekamper, D. C.; Sher, R. Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

As part of the USAEC sponsored Plant Instrumentation Program and Integrated Safeguards Experiment, nondestructive nuclear assay instrumentation was used under actual plutonium fuels fabrication conditions. Instrumentation under evaluation included calorimetry, passive neutron and passive gamma counting techniques. System capabilities were developed and defined during a qualification phase on fuel standards designed to typify difficult plutonium fuels measurement areas. Selected instrumentation was then utilized during two fuel rod fabrication campaigns. Over-all nondestructive assay instrument operating performance is discussed. Nondestructive assay results are integrated into campaign material balances showing a significant decrease in material unaccounted for values over traditional methods of accounting. (auth)

3435 (CONF-720529–, pp 237-245) LWR FUEL ROD NONDESTRUCTIVE ASSAY MEASUREMENT USING NNC PRODUCTION AND PORTABLE SYSTEMS. Miller, H. (National Nuclear Corp., Palo Alto, CA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The design, operation, and performance of two machines, the Fuel Scan and the Porta-Scan, for nondestructive assaying of fuel rods are described. The Fuel Scan, a production fuel rod assay machine, uses a multi-head detector to count fissions within a fuel rod being irradiated with an isotopic (Cf or Pu) low-energy neutron source. The detectors count emissions of gammas and neutrons in the fission process and provide information on the enrichment of material that does not contain nuclear poisons, the total fissile content of the rod, and, for a fixed enrichment, an evaluation of poison content. The Porta-Scan is a simplified, lighter version of the Fuel Scan and is used to measure fuel distribution, enrichment of BWR and PWR rods, and total fissile content. It is concluded that the nondestructive assay equipment described can be used on a routine basis for accurate measurements of Pu and U fuel rods and that such measurements provide quality assurance information on the uniformity and content of the rods and safeguards information on the total fissile content. (LCL)

3436 (CONF-720529–, pp 266-290) INVENTORY VERIFICATION MEASUREMENTS AT THE NATIONAL REACTOR TESTING STATION USING GAMAS. Ginaven, R. O.; Rundquist, D. E.; Naliboff, Y. D.; Trimble, G. D. (Gulf Radiation Tech., San Diego, CA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

In the summer of 1971 the Gulf Mobile Assay System visited the National Reactor Testing Station to conduct assay measurements. The wide variety of material on inventory at NRTS provided an excellent opportunity to extend further the range of GAMAS applications. Specifically, this was the first opportunity to assay large quantities (1 to 5 kg per container) of production-type material. Statistically significant measurements could be made quickly on these materials; consequently, for most cases the entire inventory, not just a random sampling, of a specific material was measured. Materials included in the assay measurements were UO_2 powder, PBF fuel pellets, Rover fuel elements, uranium aluminide powder, ETR and ATR fuel assemblies and ATR fuel plates. All of these measurements were conducted in conjunction with the inventory verification measurements of the AEC Idaho Operations Office. In addition to these assays a rapid survey assay was made on 200 plutonium waste barrels in a period of 3-½ days. (auth)

3437 (CONF-720529–, pp 291-298) APPLICATION OF DELAYED NEUTRON SPECTROMETRY TO NUCLEAR MATERIALS ASSAY. Shalev, S. (Technion–Israel Inst. of Tech., Haifa). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

A new nondestructive analytical technique is proposed in which the energy distribution of delayed neutrons is employed to identify nuclear materials. Active interrogation is used, but in distinction to conventional methods in which neutron counting rates are measured, the new technique is based upon the analysis of the delayed neutron energy distribution. (auth)

3438 (CONF-720529–, pp 299-314) MATERIALS MANAGEMENT: AN ANALYSIS. Baranowski, F. P. (Atomic Energy Commission, Washington, DC). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The USAEC has recently established a new organizational component to manage its nuclear materials which are currently valued at several billion dollars. The optimum use of resources, both materials and funds, requires long-term planning involving the variety of programs under the responsibility of the AEC. Accountability, as historically defined, plays an important role in this new management function. The best use of materials requires consideration of many options for analysis by management and an identification of the risks associated with alternative courses of action. (auth)

3439 (CONF-720529–, pp 326-343) MONTHLY PHYSICAL INVENTORIES IN A PILOT FUELS FABRICATION PLANT. Nilson, R.; Jaech, J. L. (Jersey Nuclear Co., Richland, WA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Experience in the conduct of monthly inventories for almost one year at a UO_2 fuels plant is summarized. The results are presented. The costs and benefits of this monthly inventory are described in qualitative terms. This plant is producing prototypical fuel for light water reactors, and the inventory control operations serve as a guide for safeguards operations in larger plants in the future. (LCL)

3440 (CONF-720529–, pp 344-358) WHERE, OH, WHERE DID MY ATOMS GO? Brobst, W. A. (Atomic Energy Commission, Washington, DC). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The solution to transportation safeguards problems in the nuclear industry that lend themselves to the overall analytical approach being used in developing solutions to the national cargo security problem is discussed. The extensive and comprehensive thinking that has gone into the study so far, as well as the many solutions already developed should be used. The solution of particular problems should be viewed in light of the national cargo security plan and the understanding that the AEC is trying to develop some sort of transportation safeguards system which will provide a type of protection which will be effective, economical, and consistent with the overall national plan. But one of the most critical items still remaining is the fact that the trend of theft in transportation will continue as long as we are willing to put up with it. (RCK)

3441 (CONF-720529–, pp 359-363) N15-7 PROPOSED ANSI STANDARD: AUDITING NUCLEAR MATERIALS STATEMENTS: WHAT IT IS AND WHAT IT IS NOT. Smith, B. F. (Price Waterhouse and Co., New York). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

A proposed standard for auditing nuclear materials accounting statements is discussed. This standard is a guide for persons making independent examinations of nuclear materials statements or reports regarding inventory quantities on hand, receipts, production, shipment, losses, etc. This standard relies upon financial auditing standards and procedures published by the American Institute of Certified Public Accountants. (LCL)

3442 (CONF-720529–, pp 364-389) EVALUATION OF THE YANKEE METHOD FOR CALCULATING URANIUM DEPLETION AND PLUTONIUM PRODUCTION IN EXPOSED FUEL. Cacciapouti, R. J. (Yankee Atomic Electric Co., Westboro, MA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Fuel discharged in 1969 from Yankee reactor Cores V and VI was reprocessed and the amount of total U and Pu and the isotopic compositions of each reprocessing dissolver batch were measured by mass spectrometric analysis. In addition, computer programs were used to calculate U depletion and Pu production and isotopic concentrations ($^{239,240,241,242}Pu$ and $^{235,236,238}U$) as a function of burnup. The calculational and data analysis methods are described and the calculated versus measured results are tabulated and compared. For the data studied, ^{239}Pu could be predicted within 4.5%, ^{240}Pu within 1.5%, ^{241}Pu within 3.1%, ^{242}Pu within 12%, fissile Pu within 4.1%, and total Pu within 3.6%. Although these differences are adequate for accountability purposes, but further improvements should be possible. (LCL)

3443 (CONF-720529–, pp 390-394) DEVELOPMENT OF A COMPUTERIZED SYSTEM FOR MATERIALS ACCOUNTABILITY. Kraft, A.; Jaech, J. L. (Jersey Nuclear Co., Richland, WA). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

Materials accountability is a safeguards tool which provides reliable assurance that no material diversion has occurred. An accountability system consists of making material balance measurements, recording the data, and reporting the results. Criteria for an accountability information system, the design of an error-free information system, and the use of computers in an accountability system are discussed. (LCL)

3444 (CONF-720529–, pp 411-423) PLANT MODELING: A GUIDE TO PLANT PERFORMANCE. Wilson, D. W. (General Electric Co., Morris, IL). Sep 1972.

From 13th annual meeting of the Institute of Nuclear Materials Management; Boston, Massachusetts, USA (31 May 1972).

In proceedings of the 13th annual meeting of the Institute of Nuclear Materials Management, Inc., Boston, Massachusetts, May 31–June 2, 1972.

The Midwest Fuel Recovery Plant (MFRP) was built to reprocess low-enriched fuel. A key requirement in the operation of this facility is the need, dictated by both economic incentives and safeguards requirements, to accurately account for special nuclear materials. A computerized plant model was developed for use in characterizing expected plant performance and to

determine that nuclear material can be accurately accounted for throughout the plant. The model can also be used in practice to monitor actual plant performance. The MFRP design, process flow, and special safeguards considerations are discussed. Steps used in modeling are presented. Model results in terms of evaluating MUF and in identifying sources of errors in MUF are described. It is concluded that the complicated task of formulating a plant model is worth the effort since the results provided an unparalleled method for estimating plant measurement capability and plant performance. (LCL)

3445 (IAEA-R-875-F) SAFEGUARDS DEVELOPMENT OF JOSE CABRERA NUCLEAR POWER STATION. Final Report for the Period February 1, 1970–January 31, 1971. Sevilla Benito, A.; Burgos, E.; Rodriguez Mayguez, E.; Bartolotti, G.; Cotarelo, J. L. (International Atomic Energy Agency, Vienna (Austria)). 1971. 29p. (In Spanish). INIS.

The purpose of applying safeguards to an off-load refueled PWR power station, e.g., the Jose Cabrera station in Spain, and also the feasibility of applying various safeguards techniques to this type of facility are discussed. Integral containment should be one of the basic principles to be applied. The three areas of containment are reactor vessel, new fuel store, and irradiated fuel storage. Applying a seal (connected to a clock to indicate the time when the seal is broken) to the shield covering the reactor cavity is the simplest and most effective containment measure. Other measures suggested are photographic surveillance of reactor head and fuel storage area, unique identification of fuel assemblies, reactor power monitoring, gamma scanning of spent fuel for identification, and monitoring of movements of the main crane. A new procedure to ensure integrity and identification of assemblies which consists of obtaining replicas of the structure of the fuel base (e.g., weld marks) is discussed. These measures should result in reasonable assurance that nuclear material has not been diverted and also that no clandestine irradiation of unsafeguarded material has taken place in the reactor. These steps would also simplify the task of the inspector at the site. (INIS)

3446 (INIS-mf-460) STUDY OF THE DETERMINATION OF THE BEST CONTROL SYSTEM OF THE FISSILE MATERIALS WITHIN THE NATIONAL NUCLEAR PROGRAMME OF THE SOCIALIST REPUBLIC ROMANIA. Popa, S. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 61p. (In Rumanian). INIS.

Thesis.

The work submitted for obtaining the Doctor Engineer degree represents a synthesis of the theoretical and experimental contributions of some I.A.E.A. groups of experts, of experts belonging to some international bodies or governments or of some individual authors, as well as the author's own contributions in a study for the determination of an optimal safeguards system on the fissile materials within the National Nuclear Programme in Romania. The central chapter of the present study analyzes the basic features of the safeguards procedures for the D_2O system in order to find ways of improvement by means of evaluations and extrapolations of some known systems. The conclusions of this study are oriented towards their concrete application in the future in order to complete the present safeguards procedures with elements appropriate for D_2O systems, when they become operational. The last chapter of the paper includes 38 bibliographical items which mostly refer to the aspects connected with the study, because, as far as this problem is concerned there is no other paper to represent the starting point of an adequate bibliography. (INIS)

3447 (KFK-1695) EXPECTED MEASUREMENT ACCURACIES AND LIMITS OF ERROR IN A FABRICATION PLANT FOR HIGH ENRICHED URANIUM. Schinzer, F.; Gupta, D.; Kraemer, R. (Kernforschungszentrum, Karlsruhe (West Germany)). Jan 1973. 28p. (CONF-720840-2). Dep. NTIS (U. S. Sales Only) $3.50.

From accuracy of nuclear materials accountancy and technical effectiveness of safeguards conference; Vienna, Austria (28 Aug 1972).

A typical fabrication plant for highly enriched uranium (HEU) was investigated concerning safeguards of nuclear material under conditions of the non-Proliferation Treaty (NPT) with respect to accountability of nuclear material. For this purpose, a hypothetical material balance area (MBA) plan with some corresponding KMP's is assumed. Particular attention was paid to the estimation of attainable measurement accuracies at the KMP's and the problem of physical inventory taking. With the help of a reference campaign the total uncertainty of the material balance including flow and inventory measurements was investigated resulting in a standard deviation of 0.5% relative to the processed material. (GF)

Disposal and Storage

Refer also to abstracts 2559, 2568, 2671, 2982, 2983, and 4599.

3448 (CEA-CONF-2225) INTERNATIONAL WASTE MANAGEMENT EXPERIENCES AND PLANS. Sousselier, Y. (Commissariat a l'Energie Atomique, Paris (France)). Oct 1972. 16p. (CONF-721109-20). Dep. NTIS (U. S. Sales Only) $3.00.

From international conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

The present situation and future outlook for radioactive waste management are discussed. An international disposal policy is suggested and a number of points regarding its acceptance are given. (TFD)

3449 (ORNL-TM-4219) SITE SELECTION FACTORS FOR THE BEDDED SALT PILOT PLANT. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 23p. Dep. NTIS $3.25.

Because of the nature of radioactive waste disposal in geologic formations, the selection of suitable sites is a unique exercise totally different from that for any other type of facility. This compilation of the various factors which must be taken into consideration was assembled as an aid in the selection and confirmation of a site for the Bedded Salt Pilot Plant. As might be expected, most of these factors are related to geologic characteristics, which are discussed under the headings of: stratigraphy; structure; hydrology; and mineral resources. Other factors concerned with geography and facility design and operation are also included. (auth)

3450 (ORNL-TM-4224) COMMERCIAL HIGH-LEVEL WASTE PROJECTIONS. Blomeke, J. O.; Nichols, J. P. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

Projections are presented of the high-level solidified wastes to be generated through the end of this century by the U. S. nuclear power industry in the course of reprocessing spent reactor fuels. The installed nuclear electric capacity of the U. S. is taken as 134, 504, and 1200 GW at the end of calendar years 1980, 1990, and 2000, respectively. The reactor complex is assumed to consist of LMFBRs, HTGRs, and U- and Pu-fueled LWRs. It is estimated that the equivalent of 471,000 ft^3 of high-level solidified wastes will have been generated through the year 2000, and that by 2010, when all of this waste has been shipped to a federal repository, it will contain 53,000 MCi of activity and evolve heat at a rate of 195 MW. (auth)

3451 STUDY OF CRITICALITY PARAMETERS AFFECTING THE HANDLING AND STORAGE OF FISSILE METAL. Altschuler, S J.; Schuske, C. L. (Dox Chemical Co., Golden, CO). Contract AT(29-1)-1106. Nucl. Technol.; 18: No. 1, 55-62(Apr 1973).

Several factors that influence the design and capacity of a fissile metal storage vault are the size and shape of individual storage units, surface density, double batching of storage units, the effects of personnel upon storage array reactivity, and the possibility of water flooding of arrays. Calculations indicate that when the fissile material is elevated 12 in. or more above the concrete floor of the vault, k_{eff} is decreased 4 to 5% when 3 in. of water is upon the concrete floor. The effect of personnel reflection upon the reactivity of an array is a strong function of the mass of a fissile unit as well as the shape and orientation of this fissile unit with regard to the reflector. For example, when a heavy flat plate of metal is held edgewise against the reflector, the value of k_{eff} is 0.804. When the plate is held flat against the reflector, k_{eff} is 1.115. A considerable penalty on storage capacity will occur if controls cannot be developed to preclude the double batching and water flooding. (auth)

3452 FATE OF RADIOACTIVE MATERIALS BURNT IN AN INSTITUTIONAL INCINERATOR. Bush, D.; Hundal, R. S. (Univ. of Birmingham, Eng.). Health Phys.; 24: No. 5, 564-568(May 1973).

The use of an incinerator for the disposal of radioactive waste, mainly animal carcasses and bedding, gave no difficulty insofar as the discharge from the stack was concerned but the matter of ash disposal and hazard to the operator required investigation. It was decided to investigate the problem in detail so that a safe operating scheme could be established. Tests were carried out on 27 radionuclides (^{14}C, ^{22}Na, ^{32}P, ^{35}S, ^{42}K, ^{48}V, ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{60}Co, ^{64}Cu, ^{65}Zn, ^{86}Rb, ^{95}Zr, ^{99}Mo, ^{110m}Ag, ^{125}I, ^{132}Te, ^{134}Cs, ^{137}Cs, ^{147}Pm, $^{175/181}Hf$, ^{182}Ta, ^{198}Au, ^{203}Hg, ^{204}Tl), the primary object being to determine the variability of retention of activity in ash under operating conditions. An account is given of the incinerator, the experimental methods, and the results of the retention studies,

together with a summary of operational surveys carried out on and around the incinerator. (UK)

Handling Equipment and Procedures

Refer also to abstracts 2772 and 3090.

3453 (EUR-4952) HANDLING EXPERIENCE WITH TRANSPLUTONIUM ELEMENTS. Buijs, K.; Muller, W. (European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). Apr 1973. 28p. (CONF-720649-5). Dep. NTIS (U. S. Sales Only) $3.50. EUR B.Fr. 50.-.

From 14th committee of hot laboratories of EURATOM; Petten, Netherlands (8 Jun 1972).

The handling of transplutonium elements of high specific activity is determined by the decay properties of these nuclides; in general, criticality can be neglected. The most important transplutonium nuclides, especially those which can be used for practical applications, decay by alpha particle emission or by spontaneous fission. Alpha and neutron radiation are accompanied by gamma and x-ray emission. Therefore, the handling and shielding requirements for transplutonium elements are different from those for plutonium or irradiated fuel. For nuclides with high specific α-radioactivity, additional problems are caused by the interaction of α particles with matter, i.e., decay heat, radiolysis, corrosion or erosion, and formation of neutrons by (α,n) reactions. (auth)

3454 (HEDL-SA-427) DESIGN OF THE FFTF FUEL HANDLING SYSTEMS BOTTOM LOADING TRANSFER CASKS. Madden, D. S.; Garrett, E. E. (Aerojet Mfg. Co., Fullerton, Calif. (USA); Westinghouse Hanford Co., Richland, Wash. (USA)). [nd]. 21p. (CONF-720903-16). Dep. NTIS $3.25.

From twentieth remote systems technology conference; Idaho Falls, Idaho, USA (17 Sep 1972).

Transfer of irradiated core components from the FFTF Reactor Containment Building into the Reactor Service Building and subsequent loading into the LMFBR shipping cask is performed by the bottom loading transfer cask and transfer dolly (BLTC/DOLLY) System. The system provides a containment boundary of inert gas, radiation attenuation, transmission of up to 10 KW of decay heat, and personnel and public safety. (auth)

3455 (K-TL-273) COMPARISON OF CONCRETE- AND WATER REFLECTED URANIUM HEXAFLUORIDE SYSTEMS. Newlon, C. E. (Oak Ridge Gaseous Diffusion Plant, Tenn). 10 Nov 1972. Contract W-7405-eng-26. 18p. Dep. NTIS $3.00.

Criticality calculations made with the ANISN transport theory code indicate that concrete is a better reflector than water, the difference in reflective properties of these media being more pronounced for fast systems, i.e., systems of fissile material whose neutron chain is maintained primarily by neutrons of energy >0.025 eV. The increase in k_{eff} attributed to replacing a water reflector with concrete is 0.12 for an 8-in. $U(100)F_6$ cylinder (fast) and 0.06 for a 5-in. $U(100)O_2F_2$ solution cylinder (thermal). Neutronic isolation distances were also found for two 5-in.-thick slabs of $U(100)F_6$. (auth)

3456 (MRR-105) CRITICALITY SAFETY OF TYPICAL TRANSPORT AND STORAGE CONTAINERS FOR HOMOGENEOUS FISSIONABLE MATERIAL. Thomas, W.; Weber, W. (Technische Universitaet Muenchen, Garching (West Germany). Laboratorium fuer Reaktorregelung und Anlagensicherung). Apr 1972. 61p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Survey criticality calculations were performed for typical container vessels for fissile materials in fuel fabrication and reprocessing used or designed in the German Federal Republic. The Monte Carlo Program KENO with GAMTEC cross sections in a 16-energy group scheme was used. The method of computation was checked against experiments. The computed k_{eff} values and the derived critical and subcritical numbers of units can help to establish safe, but not too restrictive storage arrays for various typical fissile materials. (auth)

3457 (Y-DR-107) CALCULATED CRITICALITY OF WATER MODERATED OXIDES OF URANIUM-233, THORIUM-232, AND CARBON MIXTURES. Thomas, J. T. (Oak Ridge Y-12 Plant, Tenn. (USA)). 30 Apr 1973. Contract W-7405-eng-26. 24p. Dep. NTIS $3.25.

The criticality of mixtures of ^{233}U and ^{232}Th oxides with various amounts of carbon and water are explored by calculations performed with the KENO and ANISN codes utilizing the Hansen-Roach neutron cross-section sets. The influence of varying the mixture ratios of thorium and/or carbon to uranium is evidenced. The advantages of detailed analysis of particular process operations and a suggested margin of subcriticality in the application of the calculated results in nuclear safety considerations are given. (auth)

3458 (Y-DR-109) CRITICAL THREE-DIMENSIONAL ARRAYS OF NEUTRON INTERACTING UNITS. Part IV. Arrays of U(93.2) Metal Reflected by Concrete and Arrays Separated by Vermiculite and Reflected by Polyethylene. Magnuson, D. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 30 Apr 1973. Contract W-7405-eng-26. 12p. Dep. NTIS $3.00.

Concrete-reflected, 8-unit air-spaced arrays and polyethylene-reflected, 8-unit vermiculite-spaced arrays of U(93.2)-metal cylinders have been assembled to near delayed criticality. Calculations of k_{eff} using the KENO Monte Carlo Code and Hansen-Roach 16-group cross sections are in excellent agreement with experiment, the average $\Delta k = k_{eff}(exp) - k_{eff}(calc)$ was +0.0024 for the 14 concrete-reflected experiments and for four vermiculite-spaced arrays was −0.0055. (auth)

3459 MICRO-HANDLING CELL FOR COATED-FUEL PARTICLES. Brown, P. E.; Campbell, D.; Evans, J. H.; May, F. J. (United Kingdom Atomic Energy Establishment, Harwell, Eng.). Kerntechnik; 14: No. 11, 533-539(Nov 1972).

A special lead-shielded cell with microhandling equipment was designed and built for handling and examining small-diameter coated fuel particles. This examination is necessary to obtain statistical information on the burnup and temperature behavior of coated-particle fuel for use in future high-temperature reactors. The completed cell has the following components: biological shielding; containment box; remote handling equipment; transfer hoist and bucket; vacuum cyclone clean-up system; sodium discharge light units; macro-camera; Epi-Technoscope; specimen magazine; and turntable with micro manipulator. The design and operation of each component and the performance of the equipment for identifying failed fuel particles are discussed. (LCL)

3460 GUIDE FOR NUCLEAR CRITICALITY SAFETY IN THE STORAGE OF FISSILE MATERIALS. N16.5(ANS-8.7)-1973. Hinsdale, IL; American Nuclear Society (1973). 21p.

Current storage arrangements for fissile materials, while safe, are frequently wasteful of storage capacity. Experiments with arrays of fissile materials have provided a means of validating computations and have demonstrated the safety of less restrictive mass limits and spacings for storage areas. This guide is intended to provide general storage criteria based on validated calculations and includes some engineering and administrative practices appropriate to the storage of fissile material. The tabulated mass limits presented in this guide are for idealized storage configurations that may not be commonly encountered in practice, but do provide bases for establishing safe storage arrays. Because this guide cannot effectively cover all conditions of interest, the use of supplementary information is encouraged. For example, subcriticality of arrays not specified in this guide may be confirmed by conducting neutron source multiplication measurements described in the American National Standard for Safety in Conducting Neutron Source Multiplication Measurements In Situ, N16.3-1969. (auth)

3461 AUTOMATIC SAMPLE CARRIER L4B ASSOCIATED WITH A DEVICE FOR GAMMA DETECTION AND SPECTROMETRY. Bellot, A.; Beurton, G.; Bottazzi, H.; Bussiere, P.; Laurent, A. (Institut de Recherches sur la Catalyse, Villeurbanne, France). J. Radioanal. Chem.; 6: No. 2, 453-456(Dec 1970). (In French).

A prototype automatic sample carrier, constructed of commercially available mechanical, electromechanical, and electronic components, was built. The general plan of the carrier is shown and the specifications are given. The operation of the carrier is described. (JSR)

3462 RADIOMETALLURGY II: α, β, γ LABORATORY FOR STUDYING FAST NEUTRON TYPE REACTOR FUELS. Hayet, L.; Mikailoff, H. (CEN, Fontenay-aux-Roses, France). Bull. Inform. Sci. Tech. (Paris); No. 174, 39-52(Oct 1972). (In French).

The α-β-γ laboratory of the Plutonium Fuel Department was built at the CEN Fontenay-aux-Roses site. The laboratory is intended for the study of fast reactor fuels (mixed oxides and carbides of U and Pu). The laboratory is briefly described with particular attention being given to modifications made after its initial construction. The purposes of the examinations made are discussed together with the methods developed. Emphasis is given to specific problems associated with the fuels of liquid metal cooled fast breeder reactors. (FR)

3463 APPARATUS FOR SAMPLING AND DEPOSITING SOLUTIONS. Calmon, P.; Sarrat, P. (to Commissariat a l'Energie Atomique). French Patent 2,123,593. 15 Sep 1972. Filed date 14 Jan 1971. 12p. (In French).

An apparatus for sampling and depositing solutions is described. The apparatus is particularly useful for the x-ray analysis of radioactive solutions or for the fluorimetric determination of U.

The apparatus enables small quantities of the solution under investigation to be deposited on absorbent papers without any risk of contamination, the possible error being ±1%. The apparatus is provided with a shielded box, demountable using a manipulator. The apparatus is also provided with an annular platform which rotates about its axis above a fixed base plate. This platform acts as a support for the recipients containing the solution, the sample-holders, the storage and receiving vessels, and a volumetric syringe mounted on a block which slides vertically along a column fixed to the platform. The end of the syringe, the recipients containing the solution, the sample-holders and the storage and receiving vessels are equidistant from the axis of the platform. Means are provided on the sliding block and the platform for the automatic fixing and ejecting of an interchangeable conical end piece during the descent of the syringe into the storage vessel before sampling and after the depositing of this sample on the sample-holder respectively. An electrical device ensures the operation of the syringe motor, the platform motor, and the hydraulic jack controlling the height of the syringe. (FR)

3464 HOT-CELL FACILITY FOR THE DEVELOPMENT OF FUEL REPROCESSING. Beone, G. (CNEN, Casaccia, Italy). Com. Naz. Energ. Nucl., Notiz.; 19: No. 1, 21-28(Jan 1973). (In Italian).

A system of hot cells now being completed at the Casaccia Center is described in detail. (tr-auth)

3465 ENRICHED URANIUM METAL-SOLUTION SYSTEMS SEPARATED BY NEUTRON POISONS. Tuck, G.; Clark, H. E.; Alvarez, D. L. (Dow Chemical Co., Golden, CO). Nucl. Technol.; 18: No. 3, 216-224(Jun 1973).

Critical parameters are given for a series of experiments on uranium metal spheres immersed in uranyl nitrate solution. The uranium in both regions was enriched to 93.2% ^{235}U. In some configurations, the two fissile regions were separated by $\frac{1}{3}$-cm-thick spherical shells of mild steel or boron stainless steel. These experiments were part of an investigation of the uncoupling effects of mild steel and boron stainless steel. The term "uncoupling" refers to the changes in critical mass, stated in terms of percent, due to surrounding the metal region with these nonfissile shells. Two tank sizes were used; the large tank was 38.4 cm in diameter × 57.2 cm in height, and the small tank was 26.5 cm in diameter × 38.4 cm in height. Solution concentrations used were 51.76, 54.61, 107.34, 110.27, and 448.91 g U/liter. Neutron reproduction factors were calculated for several of the experimental conditions using the KENO code. These values and their standard deviations ranged from 0.965 ± 0.013 to 1.011 ± 0.009, with uncertainties quoted at a one sigma confidence level. Neutron reproduction factors were also calculated for cases where the metal spheres were symmetrically centered in the uranyl nitrate solution. These centered cases were used to determine the uncoupling effects of the mild steel and boron stainless steel. For the 38.4-cm-dia tank, the uncoupling, expressed as a mass increase of the uranium sphere, varied from 10.1 to 65.4%. For the 26.5-cm-dia tank, the mass increases varied from 7.3 to 76.7%. The uncoupling percentage is a function of the solution concentration and the type of uncoupling material used. (auth)

3466 CRITICALITY OF PLUTONIUM NITRATE SOLUTIONS IN SLAB GEOMETRY. Lloyd, R. C.; Clayton, E. D.; Hansen, L. E.; Bierman, S. R. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Technol.; 18: No. 3, 225-230(Jun 1973).

A series of criticality experiments was performed on plutonium nitrate solutions in slab geometry. The solutions contained plutonium at concentrations ranging between 58 and 412 g Pu/ liter for material with three different isotopic contents: 4.6, 18.4, and 23.2 wt % ^{240}Pu. Acid molarites varied from 1.6 to 5.0. The experiments were performed with a variable thickness slab-type vessel of 42-in. height and width, whose thickness could be adjusted throughout a range of 3 to 9 in. The experimental vessel was used with and without a water reflector and also with a 1-in.-thick Plexiglas reflector. The critical experiment data from the finite slabs were corrected to yield values of critical thicknesses for one-dimensional infinite slabs, i.e., slabs of finite thickness but of infinite height and width. Analytical corrections, based on experimental data, were subsequently used to correct the critical infinite slab thicknesses for materials extraneous to the plutonium solutions, such as the effect of the stainless steel vessel walls and room return neutrons. The analysis provided values for clean one-dimensional assemblies that were then used as an integral check of calculational methods using cross sections from the ENDF/B-II data file. The computed values of k_{eff} for these "clean assemblies" ranged between 0.988 and 1.040; the values increased somewhat with increasing concentration. (auth)

Transportation

Refer also to abstract 3440.

3467 PLASTIC IMPACT TESTING OF SHIPPING CASK FIN SPECIMENS. Davis, F. C. (Oak Ridge National Lab., TN); Pih, H. Nucl. Eng. Des.; 24: No. 3, 322-331(1973).

An impact test program was conducted to determine the energy absorption characteristics of typical heat transfer or structural fins on shipping casks as these fins undergo dynamic, gross plastic deformation. It was assumed that the energy absorption characteristics of fins welded parallel to the longitudinal axis of a cylindrical cask are linear with respect to their length, and the test program was designed to determine the energy absorption capability per inch of fin length along the cask body. Specimens of typical fin geometries were impacted with free-falling weight dropped from known heights, and the force-time relationships occurring during each impact were recorded. A computer program was used to convert the test data into deformation–time and energy–time relationships. These relationships were correlated in a set of curves that enable the cask designer or analyst to compute the energy absorption capacity of a longitudinal fin on a cask as a function of its geometry and the percentage of deformation it is expected to experience as well as the peak force the fin would experience during the impact resulting from a 30-ft free drop into an essentially unyielding horizontal surface. (auth)

3468 TRANSPORTATION OF SPENT FUEL AND SOME PROBLEMS. Aoki, S. (Tokyo Inst. of Tech.). Genshiryoku Kogyo; 18: No. 12, 5-9(Dec 1972). (In Japanese).

Based on the reports presented at international meetings on the transport of spent fuel, the following subjects are reviewed, with emphasis on the situation in Japan, such that PWR, BWR, and FBR fuels will make issue in the future: establishment of national structure for the transport; relation with reprocessing plants; large-capacity transport containers; and development of the transport containers for future FBR fuel. In transport from power stations to reprocessing plants, the coordinative national structure among concerned circles is necessary to smooth the transport problem. Operation of reprocessing plants must be in accord with the fuel cycle of respective power plants. The transport of spent fuel containers with lead or depleted uranium as shielding by truck is a current consideration. Finally, the transport of FBR spent fuel is largely different from the case of BWR or PWR spent fuel because of higher radioactivity and decay heat. (JA)

3469 SOME EXPERIENCES OF SPENT FUELS TRANSPORTATION. Meguro, S. (Japan Atomic Power Co., Tokyo). Genshiryoku Kogyo; 18: No. 12, 29-32(Dec 1972). (In Japanese).

Spent fuel from the Tokai power station of Japan Atomic Power Company is sent to the United Kingdom. Empty casks belonging to BNFL are shipped by boat from the U. K. and are received by JAPC at a nearby port. The casks are transported to the station by trucks, and loaded with the spent fuel there, and transferred back to the ship in port. This procedure from the receipt at the port, through works at the station, and travel back to the port is described. In the station, preparation of the spent fuel, receiving the casks, spent fuel loading, decontamination, leakage testing, confirmation of work completion, and the route from the station to the port are carried out. (JA)

3470 LAWS AND REGULATIONS OF SPENT FUELS TRANSPORTATION. Nukazuka, H. (Tohoku Electric Power Co. Ltd., Sendai). Genshiryoku Kogyo; 18: No. 12, 24-28 (Dec 1972). (In Japanese).

Transport of spent nuclear fuel is becoming increasingly more important because of its high radioactivity and decay heat. Regulations of the IAEA in this connection and Japanese laws and regulations are reviewed. In Japan, though the regulations concerning land, sea and air transport are enacted, they are deficient as regards the spent fuel transport. These laws and regulations and the draft safety evaluation standard for spent fuel containers as prepared by a sub-committee in the Japanese AEC are described. Then, concerning the situation in IAEA, revision of the IAEA regulations in 1967 and 1972, along with panel meetings held in the Agency, are explained. (JA)

3471 MANUFACTURE OF TRANSPORTATION CONTAINERS FOR SPENT FUEL. Problem of Thermal Engineering. Aoki, S. (Tokyo Inst. of Tech.). Genshiryoku Kogyo; 18: No. 12, 15-19 (Dec 1972). (In Japanese).

In the thermal engineering on containers for spent fuel transport,

there are broadly two aspects, i.e., removal of decay heat and resistance against fire. For the spent fuel from light-water reactors in particular, the problem of selecting gas, liquid or solid, as a heat-transfer medium is explained. In case of the spent fuel from fast reactors with higher decay heat, the effects of fins and choice of external or internal forced cooling are described. At the time of fire, lead shielding melts, and failure occurs in the function of the containers. The problem of weight, when other materials are used as shielding, is also reviewed. (JA)

3472 DEVICE FOR HANDLING URANIUM HEXAFLUORIDE UNDER HIGH PRESSURE. Pirk, H.; Rillessen, U. (to Nukem Nuklear Chemie u-Metallurgie). German Patent 1,924,595. 9 Jun 1971. Filed date 14 May 1969 (In German).

The device is characterized by the fact that a vessel for uranium hexafluoride is enclosed in a thermally insulated tank which, in the case of the rupture of the uranium hexafluoride container, assumes the function of a receiver that is gas-tight and pressure-resistant for the uranium hexafluoride. (TSS)

3473 TRANSPORTATION ACCIDENTS: HOW PROBABLE. Brobst, W. A. (Atomic Energy Commission, Washington, DC). Nucl. News; 16: No. 7, 48-54(May 1973).

The theoretical probability of occurrence of almost any kind of transportation accident situation can be estimated with a reasonable degree of accuracy. The methodology to accomplish the analysis may be extended to different types of accidents or different types of accident consequences in terms of damage to different types of packages. With regard to the probability of serious public consequences of transportation accidents involving radioactive materials, it appears that the probability of death, injury, or massive property loss due to transportation of radioactive materials is (1) determinable; (2) not zero; and (3) very small. In projecting the total accident probability for transportation of radioactive materials to and from nuclear power plants, it seems obvious that the radiological consequences of the total accident spectrum will be several orders of magnitude below the more common non-radiological causes. (auth)

3474 STORAGE VESSEL FOR FISSILE SOLUTIONS. Schuske, C. L.; Altschuler, S. J. (Dow Chemical Co., Golden, CO). Nucl. Technol.; 18: No. 3, 305-311(Jun 1973).

A fissile solution storage vessel has been designed and analyzed which consists of a central column surrounded by intersecting arms resembling a tree with many branches. The intersecting arms are reduced at their junction with the central column to minimize the amount of surface area of an arm (which contains most of the stored liquid) in contact with the central column. Critical experiments and calculations done at Rocky Flats have shown that this area of intersection is very reactive. If this area of intersection is reduced, it is possible to increase the numbers and diameters of the arms, thus allowing more fissile material to be stored in this geometry. This method of solution storage is cost competitive with the use of borosilicate-raschig-ring-filled tanks for the storage of large quantities of fissile materials for special applications. Several such applications are storage of solutions corrosive to glass raschig rings, solutions where inorganic plutonium polymer ($PuO_2 \times H_2O$) buildup is possible and plutonium solutions in excess of 220-g Pu/liter. The tree tank can safely store 400-g Pu/liter, whereas the limiting concentration for raschig ring tanks is 220-g Pu/liter. For this particular application, the initial cost per kilogram for Pu storage is ~$53/kg for the tree versus ~$56/kg for the raschig ring tank. If one considers the cost of maintenance of the two methods over a period of five to ten years, the tree tank is competitive over an even wider range of applications. (auth)

3475 SAFETY OF RADIOACTIVE MATERIAL TRANSPORTATION. Eletti, G. (CNEN, Rome); Zambrini, R.; Forasassi, G.; Saccomano, P. Serie Simposi. (1971). vp. (In Italian).

From proceedings of the nuclear symposium; Pisa, Italy.

The experimental activity performed and its aims are described. Test facilities for containers to be used for the transportation of radioisotopes as realized at Scalbatraio Laboratory are also shown. Containers now under study and their potential uses are described, with reference to the solutions adopted for different problems. Results of the first impact tests are given. (INIS)

PARTICLE ACCELERATORS

Design, Development, and Operation

3476 (LA-5190-C) PROCEEDINGS OF THE SIXTH LAMPF USERS MEETING HELD AT UNIVERSITY OF CALIFORNIA, LOS ALAMOS SCIENTIFIC LABORATORY, LOS ALAMOS, NEW MEXICO, NOVEMBER 13–14, 1972. Partridge, S.; Howard, H. H. (comps.) (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 112p. (CONF-721124-). Dep. NTIS $3.00.

From 6th LAMPF users group meeting; Los Alamos, New Mexico, USA (13 Nov 1972).

Topics include the status of LAMPF, LAMPF operations, LAMPF electronics and equipment pool, particle physics at LAMPF, a review on pion–nucleus interactions, LAMPF nuclear physics, the biomedical channel, and the neutron irradiation damage facility at LAMPF. Also, summary discussions are presented for the working groups for the Energetic Pion Channel and Spectrometer, computer facilities, High Energy Pion Channel, Stopped Muon Channel, Low Energy Pion Channel, High Resolution Proton Spectrometer, nuclear physics laboratory, nuclear chemistry, neutrino facility, biomedical facilities, and radiation damage. The conference participants are listed. (WHK)

3477 (LBL-1399) FIRST PHASE OF HEAVY ION ACCELERATION AT THE BEVATRON. Crebbin, K. C.; Evans, D. M.; Force, R. J.; Grunder, H. A.; Guggemos, J. R.; Hartsough, W. D.; Lofgren, E. J.; Lothrop, F.; Lou, K. H.; Morgado, R.; Richter, R. M.; Tekawa, M. M.; Zajec, E. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 5p. (CONF-730310-42). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

High-energy heavy-ion beams have become a standard operational feature of the Bevatron. A diversified experimental program using these beams complements the traditional proton-physics program, and at present accounts for about one-quarter of the Bevatron operation time. Beams of ion species up to mass number 20 (neon), and with intensities up to 10^8 particles per pulse for carbon, are available on target in the extracted beam channel. Initial heavy-ion operation began a year-and-one-half ago and for the most part utilized existing Bevatron features and capabilities. Acceleration of ion species heavier than helium-ions, however, required the adaptation of a side-extracted PIG ion-source to the Bevatron pre-injector. The immediate success of this development effort and the concomitant demand for experimental beam time motivated an improvement program to provide higher beam intensities, improved beam control and monitoring, and closed-loop beam control for intensities as low as 10^6 particles per pulse. Single particle beam dynamics has been investigated. Predicted operation settings based on these studies are found to be close to actual running parameters. Losses due to recombination are well explained with existing theories for single electron capture. (auth)

3478 (LBL-1504) LBL 184-INCH SYNCHROCYCLOTRON OPERATIONAL IMPROVEMENTS. Glasgow, L. R.; Kanstein, L. L.; Sorensen, R. W.; Vale, J. T. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 4p. (CONF-730310-44). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The 184-Inch Synchrocyclotron and some of the operational improvements incorporated into it in the last few years are described. The proton beam intensity has been increased a factor of 2 by relatively simple and inexpensive means. A new beam-stretching "cee" electrode has been installed; this increases the internal stretched beam by about a factor of 2. Radiation shielding has been added which simplifies the building and modifying of experimental caves as well as providing radiation protection. The radiation monitoring system has been improved. Handling gear has been developed which eases the difficulties encountered in handling the great variety of equipment involved in cyclotron operation. An internal-external quadrupole beam focusing system is now being developed that will increase the external beam by 30%. A new patient-positioning unit (ISAH) has been installed in the medical cave. (auth)

3479 (LBL-1709) CURRENT UNDERSTANDING OF ERA. Laslett, L. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 5p. (CONF-730310-54). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

A short review is presented. Topics include problems of basic interest, single-particle resonances, coherent oscillations, transverse coherent stability, longitudinal coherent stability, collective electron–ion oscillations, radiation reaction, and expected performance characteristics (39 references.) (WDK)

3480 (LBL–1747) EARLY ACCELERATORS AND THEIR BUILDERS. McMillan, E. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 8p. (CONF-730310–55). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The early stage of accelerator development is depicted by slides and comments. Emphasis is placed on the men involved and their contributions to the field. (TFD)

3481 (LBL-1386) BEVALAC: AN ECONOMICAL FACILITY FOR VERY ENERGETIC HEAVY PARTICLE RESEARCH. Ghiorso, A.; Grunder, H.; Hartsough, W.; Lambertson, G.: Lofgren, E.; Lou, K.; Main, R.; Mobley, R.; Morgado, R.; Salsig, W.; Selph, F. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 4p. (CONF-730310-43). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

An economical means for the production of high-energy, high-intensity beams of a variety of heavy-ions is to utilize the existing LBL SuperHilac as an injector for the existing LBL Bevatron. Particle energies from 0.25 to 2.6 GeV/nucleon will be realized. The description of this facility, which will be in operation in late 1973, includes the general arrangements, the modest changes to each accelerator, beam transport line design, and a new bio-medical experimental area. (auth)

3482 PROCEEDINGS OF THE 5th INTERNATIONAL BETATRON SYMPOSIUM, BUCHAREST, OCTOBER 18–23, 1971. Bucharest; Institute for Atomic Physics (1971). 519p. (In English and Russian). (CONF-711068–).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971).

Fifty papers were presented at the conference. A separate abstract was prepared for each of 44 papers. The remaining 6 papers were not within scope of NSA. (WDK)

For abstracts of individual papers see: 2129, 2527–2529, 2706, 2890, 3483–3491, 3498, 3505–3511, 3515–3518, 3534–3541, 4061–4064, 4103, 4104, 4241, 4419, and 4420.

3483 RECENTLY FINISHED AND CONTINUING RESEARCH AND DEVELOPMENT WORK ON BETATRONS IN CZECHOSLOVAKIA. Rytina, K. (Inst. of Plasma Physics, Prague). pp 1-6 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

Topics discussed include (1) the study of the problems of electron injection and capture; (2) investigating the possibilities of increasing the energy of the existing 19-MeV betatron; (3) cooperation in developing and constructing the new medical 19-MeV betatrons; and (4) treating some of the problems pertaining to electron extraction. (WHK)

3484 SURVEY OF WORK BY THE BETATRON LABORATORY OF THE INSTITUTE OF NUCLEAR STUDIES. Janiczek, J.; Kielsznia, R.; Olszewski, J. (Inst. for Nuclear Research, Swierk, Poland). pp 7-11 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

Construction of a new 34-MeV betatron, capable of up to 150 R/min of x radiation, or of 1000 R/min of e^- radiation is described. Reference is made to metallurgical work and activation analyses in progress. (KSW)

3485 RESEARCH AND DEVELOPMENT WORK WITH THE BUCHAREST BETATRONS DURING 1966 to 1971. Baciu, G. (Inst. for Atomic Physics, Bucharest). pp 13-24 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

A short review on betatron construction, improvement, and utilization at Bucharest is given. Topics include betatron physics

and development, nuclear physics research, photoactivation analysis, radiotherapy, and nondestructive testing. (WHK)

3486 NEW 20-MEV BETATRON. Hattori, H.; Kanamori, H.; Ito, T. (Shimadzu Seisakusho Ltd., Kyoto). pp 25-28 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

A 20-MeV betatron with increased x-ray output using a higher operating frequency, a fast risetime injection pulse, and an orbit contraction circuit is described. The radiation head, pulse generators, control console, and suspension mechanism are briefly described, and radiation output is discussed. (WDK)

3487 SOME FEATURES OF THE NEW MEDICAL 19-MeV BETATRON. Rytina, K. (Inst. of Plasma Physics, Prague). pp 29-33 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Some design details and operating parameters of the 19-MeV betatron being developed in Czechoslovakia are discussed. (WHK)

3488 IMPROVEMENTS OF THE BETATRON MAGNET FOR ENERGY INCREASE FROM 19 to 22 MEV. Engel, P. (Inst. of Plasma Physics, Prague). pp 35-42 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The magnet modifications are described, and their effects on the characteristics of the magnetic field are discussed. (WHK)

3489 50-MEV BETATRON FOR INVESTIGATIVE WORK. Prokopuk, Yu. I.; Sedov, Yu. A.; Strizhak, B. I. (Kiev State Univ.). pp 115-123 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Some features of the operation of the 50 MeV betatron at Kiev State University are described: its magnet whose windings consume 450 A at 13,600 V, the vacuum system, the injection system, and electron discharge with a tungsten target. The start-up procedure and pertinent specifications are given for the betatron. (KSW)

3490 DEVELOPMENT OF BETATRONS OF SMALL DIMENSIONS WITH INCREASED SPECIFIC CHARACTERISTICS. Bel'tyaev, Yu. N.; Geizer, A. A.; Otrubyannikov, Yu. A.; Chakhov, V. V. L.; Shtein, M. M. (Tomsk Polytechnic Inst., USSR). pp 165-174 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

A 6-MeV betatron was constructed for the purpose of testing pulsed excitation of the electromagnet, and consisted of the radiation apparatus, pulsing system, condenser, and control desk. The schematic diagram for the power supply which feeds the electromagnet, and a schematic diagram of the circuits for synchronization, injection, and mixing are presented and discussed. Emphasis was placed on size and weight reduction. (KSW).

3491 . INCREASING THE EFFECTIVENESS OF UTILIZING A BETATRON. Anan'ev, L. M.; Vorob'eva, G. S.; Moskaleva, A. S.; Chernysheva, S. G.; Shtein, M. M. (Tomsk Polytechnic Inst., USSR). pp 190-195 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Various methods are briefly discussed for increasing the efficiency of betatron operation: improving its technical and economic characteristics and increasing its intensity. Stabilization of the power supply by means of a phase-pulse modulator is outlined, and the circuit diagram of the thyristor stabilizer is given. (KSW)

3492 RACE OF THE LARGE ACCELERATORS. With 400 GeV, The USA Is Clearly in the Lead: An Expensive Tool of the High-Energy Physicists. Braunbek, W. VDI (Ver. Duet. Ing.) Nachr.; 27: No. 13, 2(1973). (In German).

A short survey is given to describe the large proton and electron accelerators. The properties and problems are explained in a general manner. (GF)

3493 DEVELOPMENT AND FUTURE OF MEDICAL ACCELERATORS. Tanimura, Y. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan). Tokyo Igaku Zasshi; 80: No. 2, 77-92(Sep 1972). (In Japanese).

The principle and mechanism of accelerators applied in the medical field are discussed. The characteristics, conditions of the use and some practical problems in clinical application of medical accelerators are also described with special emphasis on the technological and physical characteristics of the linac, cyclotron, and betatron. The historical development and popular use of medical accelerators is outlined and future aspects of construction of cyclotrons and synchrocyclotrons are discussed, and the stage of construction of meson factories in 1971 is outlined and their future application discussed. (JA)

Auxiliaries and Components

Refer also to abstract 3407.

3494 (LBL-1385) METHOD OF ANALYZING THE MOMENTUM AND BETATRON AMPLITUDE DISTRIBUTIONS IN A CIRCULATING BEAM. Peterson, J. M.; Rechen, J. B. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 3p. (CONF-730310-46). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

A two-probe method of analyzing the momentum and radial-betatron-amplitude distributions in a circulating particle beam was developed. It has been used successfully in an electron-ring research program to help diagnose beam instabilities and injection techniques. (auth)

3495 (LBL-1392) LARGE RECTANGULAR VACUUM WINDOWS. Walter, J. E. (California Univ., Berkeley. Lawrence Berkeley Lab). Mar 1973. Contract W-7405-eng-48. 2p. (CONF-730310-48). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

A combination of dacron sail cloth and mylar film is used for large vacuum windows in secondary beams at the Bevatron. The dacron cloth provides the structural strength and the mylar film provides the gas barrier. Windows of this type have three principal advantages over plain mylar of equivalent strength: (1) safer, will not catastrophically fail; (2) forms square corners; and (3) less dense. The development, testing, and fabrication techniques of several such windows now in use are discussed. (auth)

3496 (LBL-1393) BEVATRON CRYOPUMP. Byrns, R. A.; Tanabe, J. T. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 4p. (CONF-730310-51). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

A cryogenic vacuum pump, designed to lower the base pressure from 2×10^{-6} torr to 3×10^{-7} torr was installed in the Bevatron in February 1972. The ~11,000 ft^3 vacuum volume contains >100,000 ft^2 of outgassing surface and is pumped with twenty-four 32-in. oil diffusion pumps. Nine cryopanels (90 ft total) were distributed around the 360-ft circumference, increasing pump capacity by 400,000 l/s for condensibles at 80°K and 140,000 l/s at 20°K. Benefits include faster pumpdowns, improved beam stability, and higher intensities. (auth)

3497 (TID-26312) OBSERVATIONS ON BEAM POSITION INSTABILITIES IN THE LINAC. Abdelaziz, M. E. (Argonne National Lab., Ill.). 20 Sep 1967. 17p. Dep. NTIS $3.00.

Beam position instabilities were observed in the ZGS injector linac beam. They were observed to occur from day to day, from hour to hour, from pulse to pulse and during the same pulse. Many factors are involved in contributing to such instabilities. More understanding of the real causes could be revealed by investigating the extent of influence of arbitrarily varied linac parameters. Such experiments will be carried out on the linac beam as soon as a ZGS shutdown is scheduled. (auth)

3498 ELECTROMAGNET OF A COMPACT 25-MeV BETATRON. Moskalev, V. A.; Nikolaev, V. L.; Sergeev, G. I. pp 157-164 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The construction of a compact high-powered betatron with yoke specifications and magnetic circuit design is described. The weight of the steel of the electromagnet, pole piece construction, and power supplies are all considered from the point of view of compactness. (KSW)

3499 FAST SQUARE PULSING AND KLYSTRON BUNCHING COUNT DOWN SYSTEM FOR A 3 MeV VAN DE GRAAFF. Fraser,

H. J.; Ritchie, A. I. M. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Nucl. Instrum. Methods; 109: No. 1, 137-143(1973).

A system is described which allows both nominally square wave modulation of the beam of a 3 MeV Van de Graaff, and counting down to lower frequencies of the 1 MHz klystron bunched beam pulses already available on this machine. The square pulses have rise and fall times of ≈17 ns and a minimum width of ≈50 ns. With the present system the pulse width can be increased by steps of nominally 100 ns to dc. The frequency range is 1 MHz to dc. The pulses are triggered externally to the machine and the jitter of the leading and trailing edges of the beam with respect to these command pulses is 3 to 4 ns and 1.5 to 2 ns respectively. (auth)

3500 CONTROL OF THE SLIP OF THE CONVERSION AGGREGATE IN THE SUPPLY SYSTEM OF A PROTON SYNCHROTRON. Akimov, G. N.; Kleopov, I. F.; Kugushev, G. I. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1303-1306(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 18-20(1972).

The principle of designing an electromechanical device consisting of an induction motor and a rectifier block for controlling the slip of a conversion aggregate operating at several tens of cycles per minute is expounded. A brief characterization of the operating mode is presented. (auth)

3501 MULTIFUNCTIONAL SYNCHRONIZATION NETWORK. Dvornikov, V. D.; Komarov, V. M.; Yudin, L. I. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1373-1376(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 78-81(1972).

A synchronization circuit is described which allows pulses that are synchronized with an accuracy of up to fractions of nanoseconds to a specified phase of an input rf voltage to be shaped over four independent channels. The time shift of the output pulses relative to one another changes with a step equal to one period of the input voltage. The scaling factor of the input-signal frequency lies in the 10 to 10^4 range. The frequency of the input signal is up to 20 MHz. Smooth delay of any output pulse within the limits of one period of the rf voltage and a driven operating mode are provided for. (auth)

3502 BEAM CURRENT AND POSITION MONITOR FOR THE ASTRON ACCELERATOR (5 DEC 1972) (ENGINEERING MATERIALS). (California Univ., Livermore. Lawrence Livermore Lab.). (CAPE-2335).

17 drawings.

Ion Sources and Injection and Extraction Systems

3503 (CEA-CONF-2197) PULSED POLARIZED ION SOURCE FOR THE SATURNE SYNCHROTRON. Bex, L.; Faure, J.; Vienet, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 8p. (CONF-720948-14). Dep. NTIS (U. S. Sales Only) $3.00.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

A study of several ionizers for ionizing a stream of polarized deuterium atoms for injection into Saturne is described. A plasma cathode ionizer, an electron emitting cathode ionizer, a reflex discharge ionizer, and an accumulation ionizer were studied and experimental results are given. It was decided to install the reflex ionizer on the preinjector because (1) the ionization efficiency is 1.2×10^{-3}, which will yield 1 μA of polarized deuterons; (2) the thermal dissipation is minimum; and (3) it provides the best stability. (WHK)

3504 (LBL-1397) 50-MeV BEVATRON INJECTION LINAC. Brodzik, D.; Lancaster, H.; Lou, K. H.; Richter, R. M.; Staples, J. W.; Tanabe, J. T.; Voelker, F.; Zajec, E. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 5p. (CONF-730310-40). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The BNL 50-MeV injection linac has been installed as a new injector for the Bevatron. The preinjector, linac modifications, and beam transfer lines are described. The linac and modulator have been modified to permit longer pulse operation at a higher peak current. Most support equipment was already on hand and modified for use. (auth)

3505 INFLUENCE OF MAGNETIC FIELD DECREASE ON TRAPPED CHARGES. Pikulik L. (Inst. of Plasma Physics, Prague). pp 63-67 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The effect of the abatement of a magnetic field of a betatron on the effectiveness of capture during injection was studied. Experimental work was conducted on the entrapped charge, measured 40 μs after injection, and also the intensity of radiation, as functions of the index of the decay of the magnetic field during injection. The trapped charge was also measured after injection and during acceleration. (KSW)

3506 INFLUENCE OF SOME FACTORS ON THE ELECTRON BEAM EXTRACTED BY PARAMETRIC RESONANCE. Badalec, J. (Inst. of Plasma Physics, Prague). pp 69-77 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The characteristics of the external electron beam, extracted by parametric resonance, depend on a number of factors. The index-coil position determines the optimum position with a view to the intensity along the beam axis, or the geometric configuration of the acceleration chamber. The dependence on the equilibrium orbit radius reflects the requirements regarding the electronic stability. Even though the radiation patterns are not quite symmetrical even at optimum regime, for practical purposes (e.g., for radiotherapy) this is not a disadvantage, because the beam must be homogenized by a dispersion foil in the direction perpendicular to the median plane. (auth)

3507 INJECTION WITH FAST ATTENUATION OF THE THREE-DIMENSIONAL CHARGE OF THE INJECTED ELECTRONS. Pikulik, L. (Inst. of Plasma Physics, Prague). pp 109-113 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The increase of entrapped charges by rapid attenuation of the azimuthal inhomogeneity of the focusing forces of a directed magnetic field was comparatively small. An experiment was conducted in which an attenuation of the injected beam occurred in the time corresponding to approximately one revolution. The magnitude of the captured charge was measured indirectly using the radiation intensity. The advantages of this method are discussed. (KSW)

3508 EXPERIMENTAL STUDIES OF ELECTRON ACCELERATOR INJECTORS WITH PIERCE- AND KERST-TYPE OPTICS. Scarlat, F.; Baltateanu, N. (Inst. for Atomic Physics, Bucharest). pp 125-143 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Results of modeling studies of Pierce and Kerst electron guns for injection into betatrons and linacs are presented and discussed. The modeling studies were performed using an electrolytic tank and a resistance network analog. (WHK)

3509 ELECTRON ACCELERATION IN A HIGH-POWER BETATRON. Moskalev, V. A.; Gromov, Yu. A.; Tsimbalist, A. V.; Shestakov, V. G. pp 145-150 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

During adjustment of the 25-MeV betatron to maximum intensity of radiation, high frequency electromagnetic waves were noticed in addition to an increase in the instability of the output. Experiments were conducted in order to obtain further information on these phenomena. The instability was believed to be associated with fluctuations in the captured current, and was determined by those processes which developed in the electron beam after injection of an excess of current. (KSW)

3510 OUTPUT OF THE ELECTRON BEAM FROM THE ACCELERATING CHAMBER OF A HIGH-POWERED BETATRON WITH REVERSED-PULSE AND ELECTROSTATIC METHODS. Moskalev, V. A.; Shashov, V. V.; Slupskii, A. M. pp 151-155 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The high-voltage generator of nanosecond pulses for a high-powered betatron is discussed. Specifications are outlined for the electron beam extracted by a pulsed, single-revolution technique and by an electrostatic method. Use of the two methods gave the capability of delivering electron beams of either nanosecond or microsecond duration. (KSW)

3511 UNSTEADY CURRENT AND THE POSSIBILITY OF ITS CAPTURE IN A BETATRON ACCELERATOR. Sokolov, O. V.; Chastokolenko, B. L. (Tomsk Polytechnic Inst., USSR). pp 175-188 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

It was found that during injection in the 15-MeV Tomsk Polytechnic Institute betatron an unsteady current of 300 mA was formed at the time that the captured current in the accelerator reached a value of about 14 mA. Methods were sought to increase the efficiency of operation of the betatron. Success was achieved by more accurate synchronization conditions and by providing for a large slope for the trailing edge of the injection pulse. (KSW)

3512 CONTROLLING THE INTENSITY OF HIGH-ENERGY PARTICLES FOR A TRACK CHAMBER. Gulyamov, U. G.; Zakharov, N. V.; Kvasov, A. I.; Kolesnik, V. G.; Losskii, I. O.; Solov'ev, M. I.; Hoi Chersung (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 6, 60-64(1972). (In Russian).

Controlling 40 GeV/c particles from a proton synchrotron using a kicker magnet for injection into a bubble chamber is discussed. Some characteristics of the magnetic field of the kicker magnet and its joint operation with the pulsed magnet are examined. A circuit diagram for the pulse forming current is presented, and the operation of the over-all assembly is described. (KSW)

3513 INCREASE IN BEAM INTENSITY IN THE INJECTOR OF THE PROTON SYNCHROTRON AT THE INSTITUTE OF THEORETICAL AND EXPERIMENTAL PHYSICS. Kapchinskii, I. M.; Batalin, V. A.; Kolomiets, A. A.; Kondrat'ev, B. K.; Kuibida, R. P. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 5, 1301-1302 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 5, 17-18(1972).

The increase in proton-beam current in the linear accelerator which serves as an injector for the proton synchrotron at the Institute of Theoretical and Experimental Physics (ITEP) to 200 mA is reported. (auth)

Ion Optics and Field Calculations

3514 (LBL-1395) NOISE IN PROTON ACCELERATORS. Hartwig, E.; Neil, V. K.; Cooper, R. K. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 6p. (CONF-730310-45). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

For a high-energy proton-electron-positron colliding beam system (PEP), it is necessary that the proton beam be stored, tightly bunched in longitudinal space, for many hours. Since there is almost no damping of synchrotron oscillations (for protons), noise which can couple to this motion may cause the protons to diffuse so as to increase the synchrotron amplitude and destroy the tight bunches. Experiments performed on the Bevatron and attempts to correlate the results with theory are described. The theory of the effect of noise in the rf system is extended to include the presence of a feedback control of the rf frequency. Although a properly designed feedback system can suppress coherent synchrotron oscillations of a bunched beam, it is found that the diffusion of particles within the bucket may be unaffected. An obvious source of noise is the rf voltage necessary to maintain the bunched structure. Other noise sources, such as collisions with residual gas, are included. (auth)

3515 FUNDAMENTAL PARAMETERS CHARACTERIZING THE MAGNETIC FIELD OF A BETATRON, AND METHODS FOR DIRECT MEASUREMENT. Gel'perin, B. B.; Fuks, L. A. pp.43-56 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Existing methods for measuring the magnetic field of a betatron are discussed, and special methods for determining the field and azimuthal inhomogeneity at the moment of injection, or at the end of the acceleration cycle are described. A final section details the measurement of the position of the magnetic median surface. (KSW)

3516 CAUSES OF FIELD INHOMOGENEITIES OF A BETATRON. Hattori, H. (Shimadzu Seisakusho Ltd., Kyoto). pp 57-62 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The measured field inhomogeneities in a betatron due to positioning of the yoke, the upper pole, and the lower pole after overhauling the betatron are studied. Correction by compensating cores and by turning the poles is discussed; and abnormal x-ray production and distortion of the electron orbit are considered. (WHK)

3517 NEW FIELD CONFIGURATIONS FOR PARTICLE FOCUSING IN CIRCULAR ACCELERATORS. Scarlat, F. (Inst. for Atomic Physics, Bucharest). pp 79-91 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

A new series of focusing schemes based on the field index as the characteristic is described. Topics include the particle trajectory through periodic structures, stability of the trajectory, the weak focusing scheme, the strong focusing scheme, the increased focusing scheme, the stepwise focusing scheme, the progressive focusing scheme, and the sawtooth focusing scheme. (WHK)

3518 ELECTRON CAPTURE, BEAM PARAMETERS, AND BEHAVIOR IN A BETATRON. Rytina, K. (Inst. of Plasma Physics, Prague). pp 95-107 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The present view of the yet unclarified process of electron capture in a betatron and the present knowledge of some of the most interesting characteristics of the electron beam during the different phases of injection and acceleration are summarized. (WHK)

Storage Rings

3519 (BNL-17792) EFFECT OF BEAM WIDTH ON THE SPACE CHARGE ν-SHIFT DUE TO IMAGE FORCES. Month, M.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 3 Apr 1973. 6p. Dep. NTIS $3.00.

The effect of beam width on the space-charge ν-shift due to image forces is estimated. Parallel plate geometry and a ribbon beam of uniform density are assumed. A small magnet gap and a large radius, which are convenient design parameters for a "warm" ISA, produce an untenable ν-shift due to image forces. However, this computation is based on the approximation of zero beam width. Furthermore, it is clear that for sufficiently large beam widths this tune shift must drop to reasonable values. The question, therefore, is whether this can be achieved for a reasonable beam size. It is concluded here that the large image tune shift caused by the large radius and small gap in the "warm" ISA design cannot be sufficiently compensated for with a reasonable beam size. (auth)

3520 (BNL-17793) EFFECT OF RF NOISE ON STORED BEAMS. Courant, E. D. (Brookhaven National Lab., Upton, N. Y.). 1973. 2p. (CONF-730310-41). Dep. NTIS $3.00.

A brief comment on the effects of rf noise on betatron and synchrotron oscillations in storage rings is given. (WHK)

3521 (LBL-1714) PEP LATTICE DESIGN. Bangerter, R.; Garren, A.; Smith, L.; Morton, P.; Rees, J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 4p. (CONF-730310-50; SLAC-PUB-1219). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Details of the current lattice design for PEP, the proton-electron-positron colliding beam system is described. This system allows collisions of protons up to 150 GeV with electrons or positrons up to 15 GeV, by storing the proton beams in a superconducting storage ring and the electrons or positrons in a concentric conventional ring, and allows collisions between electrons and positrons in the same ring up to 15 GeV. (auth)

3522 (LBL-1746) PROTON-ELECTRON-POSITRON DESIGN STUDY. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 7p. (CONF-730310-52; SLAC-PUB-1220). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The PEP (proton–electron–positron) study, a joint effort by SLAC and LBL directed toward the design of a high-energy proton–electron and electron–positron colliding beam system with center-of-mass energies of ~100 GeV and 30 GeV, respectively, is described. The history, PEP design parameters, and PEP physics are discussed. (WDK)

3523 INTERSECTING STORAGE RINGS OF CERN. Heymann, F. F. (University Coll., London). Endeavour; 32: No. 116, 81-85(May 1973).

As part of their equipment for investigating the fundamental structure of matter, and in particular the effects of high-energy collisions between protons, the European Organization for Nuclear Research has developed the Intersecting Storage Rings. Remarkable as a piece of large-scale precision engineering, the rings are already yielding valuable data and among the interesting results to emerge so far is the evidence for a possible granular structure in the proton. (auth)

3524 CERN INTERSECTING STORAGE RINGS AND STRONG INTERACTIONS AT HIGH ENERGIES. Cocconi, G. (CERN, Geneva). Contemp. Phys.; 14: No. 2, 167-186(Mar 1973).

The operation of the Intersecting Storage Rings (ISR) at the European Center of Nuclear Research (CERN), near Geneva, has made it possible in the past two years to study the behavior of matter at the highest densities ever obtained artificially, hundreds of times greater than the density of matter in nuclei and even in the most dense stars. An account is given of some of the results obtained thus far; this is followed by a brief discussion of possible future developments. (auth)

Experimental Facilities

Refer also to abstracts 2528, 2529, 2736, and 4050.

3525 (BNL–17680) PRODUCTION OF NEGATIVE PIONS OF MEDICAL INTEREST BY HIGH-ENERGY PROTONS. Berley, D.; Blumberg, L. N.; Bonar, D. C.; Fairchild, R.; Fox, J. D.; Lam, W. C.; Lazarus, D. M.; Lee, Y. Y.; Wang, C. L.; Kanofsky, A. S.; Chu, W. T.; Blecher, M. (Brookhaven National Lab., Upton, N. Y.). 1973. 5p. (CONF-730310–39). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Improvements in intensity and availability of extracted proton beams from high energy accelerators lead to the possibility of forming negative pion beams useful for treating deep-seated cancers. To optimize pion fluxes and design parameters for such beams, an experiment was performed at the Brookhaven Alternating Gradient Synchrotron to measure yields of negative pions produced by protons of 6 to 17 GeV/c incident on targets of different thickness and material. Measurements were made at production angles between 0° and 30° for pion momenta from 150 to 350 MeV/c. Pion momentum was defined by a magnetic spectrometer, and pions and electrons were identified by time of flight from target to final scintillation counter. (auth)

3526 (EUR–4896(Vol.2), pp 757–781) DEUTERIUM TARGETS AS FAST NEUTRON SOURCES ON A COMPACT CYCLOTRON. Schraube, H.; Joehlige, H.; Morhart, A. (Gesellschaft fuer Strahlen–und Umweltforschung m.b.H., Neuherberg, Ger.). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

For compact cyclotrons with a maximum deuteron energy of about E_d = 10 MeV, targets based on the D(d,n)^{3}He reaction have shown promise for radiotherapeutic purposes with regard to source strength and spectral distribution of the neutrons. The physical processes are discussed which are relevant for the generation of neutrons in a heavy water target and in a deuterium gas target. In addition, a simple calculation is made to determine the deuteron beam spreading in the target. Target constructions are shown. The cooling of the entrance window of the gas target is performed by recycling of the gas. Tests have been made on the compact cyclotron up to 40 μA deuteron beam and on a Van de Graaff generator up to a 60 μA equivalent electron beam. The spectral distribution of the neutron forward yield is calculated and is measured with a proton recoil telescope spectrometer with solid radiator and solid state detectors. The peak dose rates caused by the neutron fields are calculated by using the fluence-to-dose-conversion function. (auth)

3527 (EUR–4896(Vol.2), pp 811–820) RECIRCULATING GAS TARGET NEUTRON SOURCE FOR RADIATION THERAPY. Kelsey, C. A.; Spalek, G. C.; DeLuca, P. M.; Chenevert, G. M.; McCullough, E. C.; Nickles, R. J. (Univ. of Wisconsin, Madison). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The status of the University of Wisconsin recirculating gas target T(d,n) neutron source is described. A 21 mA, 1.2 cm diameter deuteron beam will be obtained from a duoplasmatron ion source. After being accelerated by a Pierce geometry column, the beam is electrostatically focused at a distance of 150 cm. A differentially pumped gas target is used. (WHK)

3528 (EUR–4896(Vol.2), pp 821–837) GENERATION OF HIGH NEUTRON YIELDS WITH SEALED-OFF NEUTRON TUBES. Reifenschweiler, O. (Phillips Research Labs., Eindhoven, Netherlands). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

High yields of fast neutrons are required for many applications, in particular the radiation therapy of malignant tumors. The 14-MeV neutrons generated by the ^{3}H(d,n)^{4}He-reaction in small ion accelerators are particularly suitable for the purpose. Until recently fundamental difficulties had militated against long target lifetimes at high yields. Taking earlier work of the author as the starting point, research and development were undertaken with the aim of making sealed-off neutron tubes with yields of at least 10^{12} neutrons per second and a lifetime of several hundred hours at a constant neutron output. The work was concentrated mainly on tube design, ion sources, targets and tube technology. Up till now, yields of from 5 to 7.5 × 10^{11} n/s have been obtained in life tests of some 100 hours. (auth)

3529 (EUR–4896(Vol.2), pp 849–854) NEUTRON RADIOTHERAPY EQUIPMENT OF THE HAMBURG–EPPENDORF UNIVERSITY HOSPITAL. Offermann, B. P. (AEG Telefunken, Wedel, Ger.). Sep 1972. (In German).

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The equipment of the Radiotherapy Department of the Medical Center of Hamburg–Eppendorf consisting of a Dynagen neutron generator equipped with a neutron collimator developed by AEG is described. (auth)

3530 (LBL-1376) VERSATILE PATIENT POSITIONER FOR RADIATION THERAPY. Gunn, J. T.; Lyman, J. T. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 3p. (CONF-730310-53). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Mechanical features, control philosophy, and operational characteristics are described for the automatic, computer-controlled patient positioner "ISAH." This device is presently in operation at LBL's 184-Inch Cyclotron. It is capable of positioning a patient or experimental animal to 0.1 mm accuracies in three dimensions. It can simultaneously or selectively translate the patient in three orthogonal axes and rotate him about two perpendicular axes. Translational motions are 61, 40 and 23 cm respectively while rotations are 400 deg. It is used to deliver a therapeutic dose of radiation from the cyclotron (910 MeV helium ions) to an arbitrarily defined volume within the patient's body and to manipulate the patient during irradiation so as to minimize radiation exposure of the intervening tissue. The patient motions are under on-line control of a PDP-8/I computer which directs the necessary motions and verifies their performance. The computer may also control a variable thickness water column used to vary the depth of the Bragg peak within the patient. (auth)

3531 (LBL-1382) HIGH INTENSITY STOPPED K-MESON BEAM AT THE BEVATRON. Sah, R. C.; Lou, K. H.; Wolgast, R. C.; Hoyer, E. H.; Kilpatrick, R. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 5p. (CONF-730310-47). Dep. NTIS $3.00.

From 5th particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

A high-intensity stopped K-meson beam with a design goal of 10^5 stopped K^+ per pulse is being constructed for the Bevatron. The facility is a large acceptance, 33-ft long beam line, which selects and transports 500 MeV/c K's to a stopper. The beam consists of a symmetrical arrangement of two large 90° bending magnets, three quadrupoles, and two electrostatic separators. Construction completion of this facility is scheduled for the Fall of 1973. (auth)

3532 (UCRL-74285) ROTATING TARGET FOR INTENSE 14-MeV NEUTRON SOURCE. Booth, R.; Barschall, H. H.; Goldberg, E. (California Univ., Livermore. Lawrence Livermore Lab.). 21 Feb 1973. 5p. (CONF-730310–56). Dep. NTIS $3.00.

From fifth particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The previously described intense source of 14-MeV neutrons has been observed to produce a source strength of 3×10^{12} s^{-1}, and a flux density of 7×10^{11} cm^{-2} s^{-1} on a small sample. Development work is in progress to increase the intensity further. (auth)

3533 INVESTIGATION OF THE INTENSITY DISTRIBUTION IN A NEUTRON BEAM, WHICH IS DETERMINED THROUGH THE ASSOCIATED α PARTICLES FROM THE $T(d,n)^4He$ REACTION WITH DEUTERON ENERGIES OF ABOUT 200 keV. Tagesen, S.; Nowotny, R. Oesterr. Akad. Wiss. Math. Naturwiss. Kl., Anz.; 108: 67-71(1971). (In German).

From the associated alpha particles, the intensity distribution in a neutron beam was calculated for a tritium target and a deuteron energy of 200 keV. The calculation determined first a horizontal profile which depended on the reaction kinematics; alpha scattering appeared as a minor correction. The target was subdivided into layers according to a 20 keV energy loss of deuterons. For each layer, both neutron yield and energy were computed as a function of the neutron emission angle. Then a vertical profile, perpendicular to the reaction plane, was calculated which depended essentially on alpha scattering. For the calculations, computer programs were developed in FORTRAN IV. The agreement between calculated and measured values was excellent down to about 20 percent of the maximal intensity. (HBG)

3534 RECENT DEVELOPMENTS WITH THE EXTERNAL BEAMGUIDE SYSTEM OF THE 35 MeV BETATRON. Scheer, M.; Harder, D.; Huettl, W. (Univ., Wuerzburg, Ger.). pp 249–258 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

Magnets used with the beam optics system of the 35-MeV betatron at Wuerzburg are discussed. The beam-guide magnets have the usual advantages of constant-current magnets: field precision and constancy. It should be noted, however, that pulsed magnets can be used to advantage for extraction and sampling purposes. Several pulsed magnets were developed in conjunction with the external beam. The main problem of such magnets is the requirement of low inductance. This paper summarizes basic considerations concerning the calculation of appropriate geometric configurations for quadrupole and other irrotational guide fields. The emphasis is on beam-guide magnets, whose wires were arranged on long cylindrical surfaces parallel to the cylinder axis. A pulsed sector magnet derived from the Helmholtz coil is also described, along with applications. (7 figures) (RWR)

3535 BETATRON FOR ACTIVATION ANALYSIS. Janiczek, J.; Kielsznia, R.; Olszewski, J. (Inst. of Nuclear Research, Swierk, Poland). pp 293–304 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian)

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The use of a betatron for gamma activation analysis is discussed from the viewpoint of shortening the analysis time and enhancing the sensitivity of the analysis. The B30-S betatron was assembled with these requirements in mind: 34 MeV maximum radiation energy and specified electromagnets, power supply, acceleration chamber and electron beam, and a sustained anode voltage of 50 keV. The generator of the contracted semi-sinusoidal pulse furnished an amplitude of 250 A for about 50 μs. (KSW)

3536 DEVELOPMENT OF THE PHOTOACTIVATION ANALYSIS METHOD WITH THE 25-MeV BETATRON. Baciu, G.; Galatanu, V.; Grecescu, M. (Inst. for Atomic Physics, Bucharest). pp 305–318 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

Topics include estimation of the induced activity, irradiation procedure, measuring procedure, calibration procedure, threshold sensitivity, and experimental results. (WHK)

3537 ROMANIAN INDUSTRIAL BETATRONS BETI FOR NONDESTRUCTIVE TESTING: PRESENT SITUATION AND FUTURE TRENDS. Baciu, G.; Iliescu, C.; Panaitescu, I.; Mohor, I.; Scarlat, F.; Andreescu, M.; Serdeleanu, I. (Inst. for Atomic Physics, Bucharest). pp 331–338 of Proceedings of the 5th International). Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The advantages of betatrons for industrial radiography are reviewed, and parameters of the Romanian industrial betatrons are listed. Prospective applications of industrial betatrons in Romania are discussed. (WHK)

3538 TYPE B5D-25 BETATRON FOR INDUSTRIAL DEFECTOSCOPY AT 25 MeV. Gel'perin, B. B.; Arnol'dov, V. E.; Merkul'eva, N. A. pp 339–345 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). (See CONF-711068–.

A special betatron installation was designed and built particularly for defectoscopy, with a radiation energy of 25 MeV, and delivering 100 to 120 R/min one meter from the target. The construction, power supply, and control systems are briefly discussed. (KSW)

3539 BETATRON DEVELOPMENT FOR DEFECTOSCOPY. Kononov, B. A.; Evstigneev, V. V.; Savel'ev, B. F.; Solomatin, V. I. (Tomsk Polytechnic Inst., USSR). pp 371–381 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971). (In Russian).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

Experiments showed that the electron beam of the PMB betatron may be used in connection with certain problems in medicine and dermatology and for electron defectoscopy. A large capacity and sensitivity may be obtained by the use of special machines with high currents, high stability, and good access to the beam. Reduction of the size and weight of the magnetic circuit are discussed from a theoretical viewpoint. (KSW)

3540 ADAPTATION OF THE 30-MeV IAP BETATRON FOR MEDICAL THERAPY. Scarlat, F. (Inst. for Atomic Physics, Bucharest). pp 479–487 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The irradiation geometry scheme, description of betatron, compensating filter, collimator, localization indicators, and shielding are described. Results of depth dose measurements are discussed including percentage depth dose, integral dose, and absolute dose. (WHK)

3541 CONTROLLING THE DOSE RATE OF THE BETATRON. Petersilka, F. (Siemens AG, Erlangen, Ger.). pp 489–496 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

A system for regulating the dose rate of a betatron for moving-field electron therapy is briefly described. (WHK)

3542 TARGET CHAMBER FOR THE MEASUREMENT OF CAPTURE REACTIONS. Del Bianco, W. (Univ. of Montreal). Nucl. Instrum. Methods; 109: No. 1, 189-190(1973).

A high vacuum target chamber for the study of capture reactions is described. It can be employed with solid or gaseous targets and allows the measurement of gamma ray angular distributions over a wide range of angles with a small, uniform absorption. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 3710 and 3785.

3543 (N-72-33768) MEASUREMENT OF THE DEGREE OF ANISOTROPY OF THE COSMIC RADIATION USING THE IMP SPACE VEHICLE. Final Technical Report. Palmeira, R. A. R.; Allum, F. R. (Texas Univ., Dallas). Oct 1972. 31p. (NASA-CR-130090). NTIS.

The detector and data reduction techniques used in connection with the cosmic ray experiments designed for and flown on Explorer 34 and 41 satellites are described. A history of the program development and the present status of data processing are briefly summarized. The instrument to measure the anisotropy and energy spectra of cosmic-ray electrons and protons, and x rays of solar and galactic origin is discussed. The main characteristics of the detectors and the stability during 23 months of operation are described. The method of analysis of the angular distribution of solar cosmic-ray particles in the ecliptic plane is given. It is shown that the anisotropy of low-energy particles of solar origin decreases sharply to a very small value when the satellite penetrates the magnetosphere. (auth) (STAR)

3544 (N-73-12872) STUDY OF HEAVY TRANS-IRON PRIMARY COSMIC RAYS ($Z \geq 55$) WITH A FAST FILM CHERENKOV DETECTOR. Pinsky, L. S. (National Aeronautics and Space Administration, Houston, Tex. Manned Spacecraft Center). Nov 1972. 232p. (NASA-TM-X-58102; MSC-7561). NTIS.

Thesis.

The detection and measurement of the cosmic-ray charge spectrum for nuclei heavier than iron are discussed. These trans-iron nuclei are of great interest for several reasons. They promise to be one of the more sensitive clocks for use in determining the age of cosmic rays. The discovery of radioactive nuclides and their decay products in the primary flux will allow an estimation of the elapsed time since these cosmic rays were synthesized. In addition, the relatively short interaction length of the very heavy trans-iron particles makes their relative abundance a source of information regarding the amount of interstellar matter that they had to traverse to reach the Earth. A study of the trans-iron cosmic rays may provide clues as to the very processes of nucleosynthesis by which the bulk of the trans-iron nuclei in the Universe are produced. This in turn may shed light on the mechanics of the supernova, which is postulated to be the major source of all cosmic rays. Finally, trans-iron cosmic-ray experiments may demonstrate the existence of the recently postulated super-heavy nuclei. (auth) (STAR)

3545 COSMIC RAY FORBUSH PREDECREASE, SIDEREAL ANISOTROPY, AND RELATED INTERPLANETARY PROCESSES. Gold, R. E. Denver; Univ. of Denver (1972). 164p. University Microfilms Order No. 73-9803.

Thesis (Ph. D.).

The cosmic-ray Forbush predecrease and sidereal anisotropy were analyzed to determine their implications on interplanetary cosmic-ray modulation. Theoretical models of these effects are evaluated in light of these analyses. The method of variational coefficients was extended to include a wide range of anisotropy functions, such as power law and exponential rigidity dependences, and variations of the upper limiting rigidity. (TSS)

3546 PHOTOMETRIC DETERMINATION OF THE CHARGE SPECTRUM OF LOW ENERGY PRIMARY COSMIC RAYS IN THE REGION $17 \leq Z \leq 28$. Long, C. E. Minneapolis; Univ. of Minneapolis; Univ. of Minnesota (1972). 111p. University Microfilms Order No. 73-10,602.

Thesis (Ph. D.).

A measurement is reported of the charge spectrum of primary cosmic-ray particles of low energy ($200 \leq E \leq 500$ MeV/N) detected over Ft. Churchill, Canada in a stack of nuclear photographic emulsions. The tracks of charged particles which stopped in the stack were measured using a semiautomated photometric densitometer. The data is unbiased for charges of $Z > 16$. A sample of particles of lower charge was measured for calibration purposes. After application of various corrections, the resulting density distribution showed two peaks which were interpreted as being those of particles of charge 20 and 26, calcium and iron. Estimates are given for the number of particles found of each integral charge in the range considered. Due to the present lack of understanding of the effects of interstellar propagation, it is difficult to calculate the relationship between an observed charge spectrum and a hypothetical source spectrum. A simple, and probably unrealistic, slab model of propagation predicts a path length to the source of 1 to 2 gm/cm^2 of hydrogen. This calculation indicates that calcium is present in the source. There follows a discussion of various other models of propagation and the difficulties encountered. (Diss. Abstr. Int., B)

3547 SPACE DISTRIBUTION OF THE INTENSITY OF EXCESS RADIATION AT LOW ALTITUDES. Tsaplin, V. S.; Shavrin, P. I.; Zubareva, L. V.; Savun, O. I. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 4, 498-502(1972).

Translated from Kosm. Issled.; 10: No, 555-560(1972).

By means of a single STS-5 gas-discharge counter in orbits with an apogee of ~350 km and perigee of ~200 km, inclined at an angle of 65° to the plane of the equator, measurements were made of the intensity of excess radiation with increase of magnetic field strength for fixed values of L, i.e., the existence of an altitude variation, opposite to the altitude variation of the trapped radiation. The similar form of the altitude variation is due, obviously, to the nature of the planetary distribution of the cutoff hardness at different longitudes when L ~ const. A high degree of dependence is observed between the magnitude of the local hardness of the geomagnetic cutoff and the average value of the recorded intensity. The entire set of experimental data confirms the relation between the recorded intensity and the intensity of the primary cosmic rays and permits confirmation of the assumption concerning the albedo nature of the origin of the excess radiation. (auth)

3548 TRACKS FROM EXTINCT RADIOACTIVITY, ANCIENT COSMIC RAYS, AND CALIBRATION IONS. Fleischer, R. L.; Hart, H. R. (General Electric Co., Schenectady, NY). Nature (London); 242: No. 5393, 104-105(9 Mar 1973).

Alternative explanations are discussed for the fossil tracks in lunar minerals that have been attributed to extinct superheavy element radioactivity. A brief survey of relative earlier studies is first given. It is assumed that the most abundant tracks are due to Fe, but they have been altered over time, either by heating or by deformation. Based on extrapolations of laboratory annealing experiments, tracks in most meteoritic and lunar crystals exposed to the expected temperatures should be stable and unaltered throughout their cosmic-ray exposure times. If, however, the usual exponential form of annealing kinetics were to break down by the intervention of a second mechanism with a lower activation energy it would be possible for annealing to occur, but there is no evidence for such an effect. There is, however, evidence for mechanical effects. Most samples from the lunar surface have been exposed to shock from the agency that broke them from lower rocks, and meteorites have been bombarded in space, experienced high pressures as they encountered the Earth's atmosphere, and shock by impact with the ground. Shortening of fission fragment tracks lengths was measured as a function of shock pressure for specimens of apatite from granodiorite shocked to pressures of 11 to 30 k bar. (UK)

3549 CONTRIBUTION OF ATMOSPHERIC MULTIPLE NEUTRON PRODUCTION TO THE MULTIPLICITY DISTRIBUTION OBSERVED IN COSMIC-RAY NEUTRON MONITORS. Fujii, Z.; Kodama, M. (Inst. of Physical and Chemical Research, Tokyo). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 271-279(Dec 1972).

Some experimental results of the multiple events due to the multiple neutron productions in the atmosphere were presented from measurements performed in two different methods on Mt. Norikura. The experimental arrangement to measure the decoherence curve of the atmospheric multiple neutron events with two neutron monitors with the same geometry is explained. Each of the monitors was constructed by the use of eleven IGY-type neutron counters. The second method measures the multiple neutron events accompanied with extensive air showers. This is based on the fact that one of the main sources of the atmospheric multiple neutron events is thought to be due to the nucleonic component in air showers. The continuous observation of small size air showers has been made on Mt. Norikura, using a multi-directional large area cosmic-ray telescope. The equipment description is given. Results show that the contribution of the atmospheric multiple neutron events outside the neutron monitor is less than 2 per cent of the total multiple neutron events observed in the neutron monitor. (JCW)

3550 RELEVANCE OF COSMIC RAY DATA ABOVE 10^{12} eV TO MODELS OF HIGH ENERGY INTERACTIONS. Wdowczyk, J.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 4, L48-L51(Apr 1973).

Recent experiments on proton-proton collisions with the inter-

secting storage ring facility have shown a number of features which may be explained by the high-energy "scaling" model of Feynman (Phys. Rev. Lett.; 23: 1415-7(1969)). Cosmic-ray data were examined in some detail to 10^{18} eV and it was found that they do not support the model being valid, at least without serious modification, to these much higher energies. (auth)

3551 INTEGRAL MULTIPLICITY OF THE MUON COMPONENT OF COSMIC RAYS. Boos, E. G.; Efimov, A. K.; Kolomeets, E. V.; Kupchishin, A. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 45-50(1972). (In Russian).

A method for calculating the integral multiplicity of the muon component of cosmic rays is proposed which allows for the angular distribution of secondary particles in the elementary act. The computer "URAL-2" facilitated the computation, and the results obtained were compared with experimental data. (tr-auth)

3552 INTRODUCTION TO COSMIC RAY PHYSICS. Volume 1. Particle Detection. High Energy Physics (Extensive Air Showers). Dupuy, J. E. Paris; Doin (1972). 180p. (In French).

The information obtained from cosmic radiation in the fields of high-energy nuclear physics and astrophysics is discussed together with the different types of detector used to study primary and secondary cosmic rays and to detect showers. An experimental and theoretical investigation of extensive air showers is presented. (FR)

3553 SIMPLE MODEL FOR SCANNING-ANGLE DISTRIBUTION OF PLANETARY ALBEDO GAMMA-RAYS. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, MD). Nature (London) Phys. Sci.; 242: No. 117, 59-60(26 Mar 1973).

A simple model is discussed for calculating the planetary albedo scanning angle distribution for γ radiation >100 MeV, and the results are compared with observation. Geomagnetic effects are neglected. The planetary atmosphere is scanned from a satellite, and a primary cosmic ray is considered to enter the atmosphere and collide with an atmospheric nucleus, the resulting secondary γ ray being detected. An expression is derived for the angular distribution of the γ rays in the laboratory system, assuming that most of the flux above 100 MeV comes from π^0 mesons isotropically produced in the center of mass system of the collision. It is also assumed that the baryons in the nucleus act as if unbound at energies >1 GeV, and that the atmosphere is isothermal. The calculated results are compared with some of those obtained from OSO-3 for high geomagnetic latitudes, and good agreement found. An interesting possibility is that the mean total baryonic scale height may be deduced from the angular distribution of the γ-ray flux, without having to determine chemical composition and temperature. The structure of a planetary magnetosphere might also be studied. (UK)

3554 LOW MOMENTUM INTEGRAL MUON SPECTRUM AT SEA LEVEL NEAR THE GEOMAGNETIC EQUATOR. Bhattacharyya, D. P. (Presidency Coll., Calcutta). J. Phys., A (London); 6: No. 4, 582-587(Apr 1973).

The vertical cosmic muon spectrum at sea level in the momentum range 0.32 to 3 GeV/c was measured near the geomagnetic equator (at 12°N) by means of a flash-tube range spectrograph. The results were compared with others obtained at similar and higher latitudes. (auth)

3555 ISOTOPIC COMPOSITION OF GRAPHITIC CARBON FROM IRON METEORITES AND SOME REMARKS ON THE TROILITIC SULFUR OF IRON METEORITES. Deines, P.; Wickman, F. E. (Pennsylvania State Univ., University Park). Geochim. Cosmochim. Acta; 37: No. 5, 1295-1319(May 1973).

The carbon isotopic composition of graphite inclusions and finely dispersed carbon from twelve iron meteorites has been studied. The analyses are given as parts of permil deviations from the PDB standard. Forty-five analyses of inclusion-graphites from four coarse-grained octahedrites fall in the range from −4.8 to −8.2%; within some of the inclusions a ^{13}C depletion towards the rim of the nodules is observed. Finely dispersed, residual carbon from four coarse octahedrites, obtained by dissolving the meteorite, shows distinctly lighter isotopic composition ranging from −5.6 to −24.1%, probably representing a mixture of small inclusions and flakes as well as carbon contained in carbides or in solid solution in the nickel−iron. Graphite inclusions showing ^{13}C concentrations outside the above range for inclusion-graphites were found in (1) two octahedrites with silicate inclusions, i.e., Four Corners (−4.0%) and Pine River (−8.7%); (2) the hexahedrite Kendall County (−13.3 to −14.4%); and (3) the "ataxite" Dayton (−11.5 to −11.8%). This suggests that the average carbon isotopic composition may not be identical for all iron meteorites. The large variability in the ^{13}C concentration encountered within individual irons contrasts with the isotopic constancy of sulfur observed in meteorites. It is proposed that the differences in the isotope distribution patterns of the two elements may be understood on the basis of the chemical phase relationships in the system Fe−Ni−S−C. However, while $\delta\ ^{13}C$ variations within a meteorite may be discussed within this framework, little can be said as yet about possible causes for the suggested differences in ^{13}C concentrations between different meteorites. (auth)

3556 ABUNDANCE OF 17 TRACE ELEMENTS IN CARBONACEOUS CHONDRITES. Kraehenbuehl, U.; Morgan, J. W.; Ganapathy, R.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 5, 1353-1370(May 1973).

Seventeen trace elements (Ag, Au, Bi, Br, Cd, Cs, Ge, In, Ir, Rb, Re, Sb, Se, Te, Tl, U, and Zn) were measured by neutron activation analysis in 8 C1 samples (1 Alais, 3 Ivuna, 4 Orgueil) and in 3 C2 samples (one each of Mighei, Murchison, Murray). The results show far less scatter than earlier literature data. The standard deviation of a single measurement from the mean of 8 C1 samples lies between 2 and 14%, except for the following 4 elements: Au ± 18%, Ag ± 22%, Rb ± 19%, and Br ± 33%. The first two probably reflect contamination and sample heterogeneity, the last two, analytical error. Apparently C1 chondrites have a far more uniform composition than some authors have claimed. The new data suggest significant revisions in cosmic abundance for the following elements (old values in parentheses): Zn 1250 (1500), Cd 1.51 (2.12), Ir 0.72 (0.43) atoms/10^6 Si atoms. The Br value is also lower, 5.8 vs 20.6, but may be affected by analytical error. Relative to C1 chondrites, the C2 chondrites Mighei, Murchison, and Murray are depleted in volatile elements by a factor of 0.508 ± 0.038, much more constant than indicated by older data. Ordinary chondrites also show a more uniform depletion relative to the new C1 data. The mean depletion factor of Sb, F, Cu, Ga, Ge, Sn, S, Se, Te, and Ag is 0.227 ± 0.027 in H-chondrites. This constancy further strengths the case for the two-component model of chondrite formation. (auth)

3557 SOLUBILITIES OF NOBLE GASES IN MAGNETITE. Implications for Planetary Gases in Meteorites. Lancet, M. S.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 5, 1371-1388(May 1973).

Solubilities of noble gases in magnetite were determined by growing magnetite in a noble-gas atmosphere between 450 and 700°K. Henry's law is obeyed at pressures up to 10^{-2} atm for He, Ne, Ar, and up to 10^{-5} atm for Kr and Xe, with the following distribution coefficients at 500° (cc STP g^{-1} atm^{-1}): He 0.042, Ne 0.016, Ar 3.6, Kr 1.3, Xe 0.88, some 10^2 to 10^5 times higher than previous determinations on silicate and fluoride melts. Apparent heats of solution in kcal/mole are: He − 2.42 ± 0.12, Ne − 2.20 ± 0.10, Ar − 15.25 ± 0.25, Kr − 13.0 ± 0.3, Xe − 12.5 ± 0.05. These values, too, stand in sharp contrast with earlier determinations on melts which were small and positive, but are comparable to the values for clathrates. Presumably the gases are held in anion vacancies. Extrapolation of the magnetite data to the formation temperature of C1 chondrites, 360°K, shows that the $^{36}Ar_p$ content of Orgueil magnetite could be acquired by equilibrium solubility at a total nebular pressure of 4×10^{-6} atm. In the absence of data for silicates (the principal host phase of planetary gas), an attempt is made to estimate the solubilities required to account for planetary gases in meteorites. These values do not appear grossly unreasonable in the light of the magnetite data, when structural differences between the two minerals are taken into account. It seems that equilibrium solubility may be able to account for four features of planetary gas: elemental ratios, amounts, correlations with other volatiles, and retentive siting. It cannot account for the isotopic fractionation of planetary gas, however. (auth)

3558 COSMIC RAY SOURCES: EVIDENCE FOR TWO ACCELERATION MECHANISMS. Ramaty, R.; Balasubrahmanyan, V. K.; Ormes, J. F. (Goddard Space Flight Center, Greenbelt, MD). Science; 180: No. 4087, 731-733(18 May 1973).

The difference between the energy spectra of iron and other cosmic rays is interpreted in terms of two source mechanisms. One mechanism, possibly acceleration at neutron-star surfaces, produces the iron, and another is responsible for the rest of the primary nuclei. Within this model, observations of high-energy cosmic rays could determine whether secondary nuclei are produced in the sources or in the interstellar medium. (auth)

3559 COUPLING COEFFICIENTS OF $\mu^{\pm}$-MESON COMPONENTS ALLOWING FOR THE ANGULAR DISTRIBUTION OF PRIMARY COSMIC RADIATION. Boos, E. G.; Efimov, A. K.; Kolomeets, E. V.; Kupchiskin, A. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 51-56(1972). (In Russian).

Coupling coefficients of the $\mu^{\pm}$-meson component of cosmic rays

were calculated on the basis of the interaction of primary protons with nuclei of the atoms of air. The angular distribution of primary and secondary particles was computed with regard to the coefficient of inelasticity and to the transverse momentum. (tr-auth)

3560 COSMIC RAYS IN THE OUTER SOLAR SYSTEM. Parker, E. N. (Univ. of Chicago). Space Sci. Rev.; 14: No. 3-4, 576-581(1973).

A space mission to Jupiter and Saturn, and beyond, provides an opportunity to explore the low-energy galactic cosmic rays, which are largely excluded from the inner solar system by the outward sweep of the magnetic fields in the solar wind. The low-energy cosmic rays are believed to be responsible for much of the heating of the gaseous disk of the Galaxy, so a measurement of their intensity will have far reaching effects on theories of the interstellar gas and the evolution of the Galaxy. The nuclear abundances, and in particular the presence or absence of high Z nuclei, will give critical information on the proximity of cosmic-ray sources. (auth)

3561 SEARCH FOR COSMIC RAYS STREAMING OUT OF THE GALAXY. Fenton, A. G.; Fenton, K. B. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Aust.; 2: No. 3, 139-140(Oct 1972).

Three G-M counter telescopes are operating 450 ft underground at a counting rate of ~1600 muons/h in an attempt to determine whether there are any meteorological influences which affect the muon intensity significantly. (AT)

3562 ELECTRON SPACE DISTRIBUTION IN INHOMOGENEOUS ATMOSPHERE. Guzhavin, V. V.; Ivanenko, I. P.; Paskhalov, Yu. I. (Moscow State Univ.). Yadern. Fiz.; 16: No. 4, 748-754(Oct 1972). (In Russian).

The calculations are made of the space distribution functions (SDF) for electrons in a cascade shower, developing in the inhomogeneous atmosphere with no account for ionization losses. An approximated way of estimating the influence of atmospheric inhomogeneity on SDF, calculated with account for ionization losses, has been worked out. The results on calculating SDF of electrons in inhomogeneous atmosphere are compared with the experimental data on extensive atmospheric showers. (auth)

Stars

3563 IONIZATION-ZONE INSTABILITY AS THE CAUSE OF PLANETARY NEBULAE. Scott, E. H. III Princeton, NJ; Princeton Univ. (1972). 46p. University Microfilms Order No. 73-9644.

Thesis (Ph. D.).

In order to theoretically approach the problem of the origin of planetary nebulae, a mass-loss process from a 1 $M_{\odot}$ red giant was simulated using a quasi-static series of models in hydrostatic equilibrium. Two types of model series were constructed: one constraining the star to adjust itself adiabatically after mass removal, and the other allowing it to adjust itself to thermal equilibrium. Tests of the stability against adiabatic perturbations were carried out for each of these series. It is shown that the thermal equilibrium case is the more physically preferred description of the mass-loss process. The mass-loss continues until all but a fraction of one percent of the star's envelope is stripped off. Investigation of the nonadiabatic stability of the star shows that a) the star behaves in a quite different manner than it does with respect to adiabatic perturbations, and b) the star is pulsationally unstable without mass-loss for a wide range of luminosity—a result which may be connected with pulsation in long-period variables. (Diss. Abstr. Int., B)

3564 PRIMORDIAL HELIUM ABUNDANCE AND POPULATION II BINARY STARS: A NEW MEASUREMENT TECHNIQUE. Wickes, W. C. Princeton, NJ; Princeton Univ. (1972). 161p. University Microfilms Order No. 73-9663.

Thesis (Ph. D.).

A new instrument was developed to measure the separation and position of close binary star systems. In particular the instrument is intended to measure Population II binary stars where the separation is so small (less than one arcsecond) and the magnitude difference of the two components so large that previous measurement methods are inaccurate or unsuccessful. Angular resolution is achieved by interferometric techniques; the effects of atmospheric turbulence are minimized by high frequency chopping and synchronous integration on a Computer of Average Transients. The orbital measurements, together with known distance measurements and orbital periods, yield the masses of the stars. A measurement of luminosity plus a theoretical mass-luminosity relationship yields information about the chemical composition of the stars, in particular the helium abundance. The helium abundance of Population II stars reflects the helium content of the primeval fireball of the Big Bang cosmology which constitutes an important test of general relativity and the Brans-Dicke scalar tensor theory. At present there are no reliably known masses of Population II stars. A particular objective of the program is resolution of the binary μ-Cassiopeia. (Diss. Abstr. Int., B)

3565 COMPARISON OF THE MIXING-LENGTH THEORY OF CONVECTION WITH THE LINEAR MODE APPROACH. Hart, M. H. Princeton, NJ; Princeton Univ. (1972). 56p. University Microfilms Order No. 73-9613.

Thesis (Ph. D.).

Model stars whose convection zones had been prepared in accordance with the standard mixing-length theory were used as a basis for the computation of unstable convective modes. It was found that no superposition of statistically independent, nonviscous, adiabatic, convective modes can reproduce the radial dependence of the convective flux of the model. This implies an inconsistency between the linear mode approach and the mixing-length theory. It is also shown that if the linear scale of convective motions is greater than (or of the same order as) the pressure scale height then the fractional deviation of the pressure from equilibrium will not be negligible, as assumed in the mixing-length theory, but will be at least of the same order as the fractional deviation of the density from equilibrium. (Diss. Abstr. Int., B)

3566 TWO FLARE STARS BEHIND THE PLEIADES. Weaver, W. B.; Naftilan, S. A. (Case-Western Reserve Unit., Cleveland). Publ. Astron. Soc. Pac.; 85: No. 504, 213-214(Apr 1973).

The flare stars H_{II} 230 and H_{II} 1069, both nonmembers of the Pleiades, were observed at 200 Å mm^{-1}. These stars are well behind the Pleiades and do not show Ca II or hydrogen emission. The spectral type of H_{II} 230 is earlier than that of any other known UV Ceti-type star. (auth)

3567 HELIUM-RICH STAR HD 184927. Higginbotham, N. A.; Lee, P. (Louisiana State Univ., Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 504, 215-219(Apr 1973).

A preliminary analysis of HD 184927 yields a helium-to-hydrogen ratio of 2.0, T_{eff} = 22,000°K, and log g = 3.38. A comparison is made with similar type stars. (auth)

3568 WOLF-RAYET SPECTROSCOPIC BINARY HD 92740. Niemela, V. S. (Instituto de Astronomia y Fisica del Espacio, Buenos Aires). Publ. Astron. Soc. Pac.; 85: No. 504, 220-223 (Apr 1973).

A radial velocity study of HD 92740, a WN7 star, shows it to be a binary with P = 10.04d. Preliminary velocity curves derived from various lines suggest differing amplitudes; and the weak hydrogen absorption lines present in the spectrum share the orbital motion of the WN star. Undetected violet absorption is shown to cause the redward displacement of He II λ4686. The possibility of an outward accelerating atmosphere is suggested by the presence of a Balmer progression. (auth)

3569 TRIGONOMETRIC PARALLAX DETERMINATION FOR THE CENTRAL STAR IN THE PLANETARY NEBULA NGC 7293. Dahn, C. C. (Naval Observatory, Flagstaff, AZ); Behall, A. L.; Christy, J. W. Publ. Astron. Soc. Pac.; 85: No. 504, 224-226(Apr 1973).

Plates obtained with the 61-inch astrometric reflector yield a relative parallax of 0.001 ± 0.005 (m.e.) for the central star in the planetary nebula NGC 7293. This result contradicts the value of 0.038 ± 0.015 (m.e.) obtained by van Maanen (1923). (auth)

3570 MAGNETIC NULL LINES OF ASTROPHYSICAL INTEREST. Adelman, S. J. (Goddard Space Flight Center, Greenbelt, MD). Publ. Astron. Soc. Pac.; 85: No. 504, 227-229(Apr 1973).

A line list is presented for magnetic null lines found in the Ultraviolet Multiplet Table and in selected spectral analyses for use in detailed studies of magnetic peculiar A star atmospheres. (auth)

3571 COPLANARITY IN OPEN CLUSTERS. Ferrer, O.; Jaschek, C. (Observatorio Astronomico, La Plata). Publ. Astron. Soc. Pac.; 85: No. 504, 207-212(Apr 1973).

A new procedure is given for deriving the distribution of the orbital planes of binaries in clusters, based upon the statistics of the observed mass functions. Tables are provided for applications of the method. The procedure is applied to IC 4665 and an average inclination of 45° and a small dispersion of the inclinations is found. (auth)

3572 VARIABILITY OF CASE 621 AND MSB 57. Baumert, J. H. (Univ. of North Carolina, Chapel Hill). Publ. Astron. Soc. Pac.; 85: No. 504, 205-206(Apr 1973).

The unusual SC star Case 621 is identified with the variable VX Aql and the variability of the carbon star MSB 57 is reported. (auth)

3573 MAGNITUDE SEQUENCE FOR THE VARIABLE STAR ST MONOCEROTIS. Landolt, A. U. (Louisiana State Univ., Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 504, 203-204 (Apr 1973).

A UBV photoelectric sequence was established in the neighborhood of the variable star ST Mon. A finding chart is provided. (auth)

3574 EXPANSION OF NGC 7293. Grandi, S. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 85: No. 504, 200-202(Apr 1973).

An attempt was made to measure the expansion of NGC 7293 by measuring the filament positions on two 200-inch plates taken nineteen years apart. No evidence for a common expansion or contraction is seen. (auth)

3575 NEW EMISSION-LINE STARS IN OH CLOUDS. Grasdalen, G. L. (Univ. of California, Berkeley); Kuhi, L. V.; Harlan, E. A. Publ. Astron. Soc. Pac.; 85: No. 504, 193-199(Apr 1973).

Eleven dust clouds exhibiting radio OH lines were surveyed for Hα emission-line stars. Eight new objects were discovered in four such clouds and none in the remaining seven to a limiting magnitude of $m_v \simeq 18$. The objects are most likely T Tauri stars. (auth)

3576 DETECTION OF THE SECONDARY SPECTRUM IN SX CASSIOPEIAE. Andersen, J. (Univ. of Copenhagen). Publ. Astron. Soc. Pac.; 85: No. 504, 191-192(Apr 1973).

The detection of the secondary spectrum in SX Cas is reported. Lines of Fe I $\lambda\lambda$4045, 4063, and 4071, as well as other features, are doubled near phases 0.25 and 0.75P. (auth)

3577 SEARCH FOR RAPID SPECTRAL VARIATIONS IN 10 LACERTAE. Glaspey, J. W.; Walker, G. A. H. (Univ. of British Columbia, Vancouver). Publ. Astron. Soc. Pac.; 85: No. 504, 188-190(Apr 1973).

The spectrum of 10 Lac in the Hδ region was observed using a low light-level image isocon system to search for rapid spectrum variations. Two sets of observations covering 31 and 32 minutes, respectively, as well as a number of shorter observations covering an additional 30 minutes, did not reveal any line depth variations greater than ~25% in either the O II λ4119 or other spectral lines. (auth)

3578 TECHNETIUM IN S SCULPTORIS. Cohen, J. G. (Univ. of California, Berkeley). Publ. Astron. Soc. Pac.; 85: No. 504, 187(Apr 1973).

Evidence is given for the presence of technetium in S Scl, a long-period Me variable. (auth)

3579 INFRARED SPECTRUM OF X CYGNI FROM 4000 TO 6700 cm^{-1}. Johnson, H. L. (Univ. of Arizona, Tucson); Thompson, R. I.; Forbes, F. F.; Steinmetz, D. C. Publ. Astron. Soc. Pac.; 85: No. 504, 179-186(Apr 1973).

The infrared spectrum of χ Cyg from 4000 to 6700 cm^{-1} is presented. Preliminary identification of atomic and molecular features were made. χ Cyg shows the most intense CO bands observed to date in any star. The bearing of these bands on observed $^{12}C/^{13}C$ ratios is discussed. (auth)

3580 SEARCH FOR AP STARS WITH VERY LONG PERIODS. Wolff, S. C.; Morrison, N. D. (Univ. of Hawaii, Honolulu). Publ. Astron. Soc. Pac.; 85: No. 504, 141-149(Apr 1973).

Four-color (uvby) photoelectric observations yielded new periods for three peculiar A-type stars. For HD 8441, the period P was equal to 69.5 days, for HD 12288, P = 34.9 days, and for HD 216533, P = 17.20 days. The period of 12.448 days derived by Preston (1972) for HD 24712 was confirmed. The periods of HD 18078 and HD 2453 are longer than one year. These results nearly double the number of Ap stars known to have periods longer than 25 days and add weight to the evidence that magnetic stars undergo rotational deceleration during their lifetimes. (auth)

3581 5-μm INFRARED EMISSION FROM ALGOL. Jameson, R. F.; Longmore, A. J.; Crawford, B. (Univ. of Leicester, Eng.). Nature (London); 242: No. 5393, 107-108(9 Mar 1973).

A number of 5μm observations of the eclipsing binary β Per (Algol) made during September, 1971, using the 60 inch infrared flux collector at Izana, Tenerife, are described. There was clearly an infrared excess of 1.2 mag, not coming from component stars of the Algol system. The excess can be explained by free–free emission from an ionized H plasma cloud, but because observations were made at only one wavelength a definitive model could not be provided. A cloud of radius 15 $R_\odot$, temperature 10,000 K, and electron density $10^9/cm^3$ would radiate the required 5μm flux. (UK)

3582 BETA CANIS MAJORIS. Period Analysis of Recent Photometry and Published Radial Velocities. Shobbrook, R. R. (Univ. of Sydney). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 257-267(1973).

Beta Canis Majoris has been observed in yellow light, mainly during the 1971/1972 season. The light variation with the 6-hr period (P_1) has one-quarter of the amplitude of the 6 hr 2 m period (P_2), whereas in the velocities published from 1908 to 1954 and re-examined in this paper, P_1 has a 50% larger variation than P_2. Both periods are changing, P_1 having increased since 1908 and P_2 decreased. In addition, a period of 5 hr 44 m is found to be present in most of the available data; the amplitude of the light and velocity curves at this period are small and variable. (auth)

3583 ABUNDANCE ANALYSIS OF THE F-TYPE GIANT HD 116745 IN THE GLOBULAR CLUSTER OMEGA CENTAURI. Dickens, R. J.; Powell, A. L. T. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 249-255(1973).

Spectrograms obtained with a McGee spectracon image tube at a dispersion of 22.5 Å mm^{-1} have been used for a differential curve-of-growth analysis of the F giant HD116745 in ω Cen. The principal result of the analysis of one spectrum yields a logarithmic iron-to-hydrogen ratio with respect to the Sun of [Fe/H] = -1.2 ± 0.3 (estimated error), as compared to a value ~-1.7 expected for cluster giants from ultraviolet excess and Deutsch/Kineman classification. A mass of 0.37 $M_\odot$ $^{+0.3}_{-0.18}$ is derived from the temperature, gravity, and luminosity. A brief discussion of possible interpretations of these results is given. (auth)

3584 MODIFIED LUCY MODEL FOR W URSAE MAJORIS SYSTEMS. Moss, D. L.; Whelan, J. A. J. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 239-248(1973).

The model of Lucy (Astrophys. J.; 151: 1123 (1968)) for W UMa systems is modified and model contact binary systems are constructed with unequal specific entropies in the adiabatic parts of the convection zones of the components, with energy being allowed to be transferred between the superadiabatic parts of the convection zones. The effect of a difference in mixing length between primary and secondary is also investigated. Zero-age main sequence systems with components of approximately equal colour are produced which occupy the low period, red colour part of the period–colour diagram, which is inaccessible to the basic Lucy models. (auth)

3585 MODELS FOR RAPIDLY ROTATING PRE-MAIN SEQUENCE STARS. Moss, D. L. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 225-237(1973).

Approximate models of rapidly rotating largely convective low-mass stars contracting homologously to the main sequence are constructed. The effects of rotation on times for contraction to the main sequence are discussed, and it is concluded that discrepancies in the estimates of ages of young clusters may be increased if a coeval origin of the cluster members is retained. (auth)

3586 VISCOUS ACCRETION FLOWS AND THEIR UNIQUENESS. Balazs, N. L. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 217-233(1973).

It is shown that the bifurcation point in a nonviscous accretion flow comes about because (a) the energy-surface of a fluid particle partaking in the flow has a saddle point for $v \neq 0$; (b) the velocity curves v(r) are level curves of the energy surface; the saddle point is a bifurcation point of the level surface. If the fluid is slightly viscous the velocity curves are no longer level curves and the viscous terms in the equation guide the solution curve in a unique way across the saddle point. However, the qualitative appearance of the velocity field as a function of the accretion is hardly altered by the presence of a small viscosity, since the structure of the energy surface on which the solution curves run is not changed by the presence of a small dissipation. (auth)

3587 INTERSTELLAR SPECTRUM OF HD 154368. Blades, J. C.; Bennewith, P. D. (London Univ.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 213-216(1973).

Strong absorption lines of the interstellar species Ca^+, CH, CH^+, and Cn have been detected in the spectrum of the O type star HD 154368. There is evidence that these interstellar species lie in gas situated close to the Sun, and also that the molecular species are more localized in space than is the interstellar Ca^+. (auth)

3588 OBSERVATION AND INTERPRETATION OF THE INFRARED SPECTRUM OF ETA CARINAE. Robinson, G.; Hyland, A. R.; Thomas, J. A. (Melbourne Univ., Parksville, Australia). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 281-292 (1973).

Infrared spectral scans of eta Carinae in the wavelength range

8 to 13 μm are presented together with new broad-band photometric measurements. These observations show that the spectrum of η Carinae exhibits a feature in the 8 to 13 μm region characteristic of thermal emission from silicate grains, thus providing additional evidence that the large infrared flux is due to absorption and thermal re-radiation by particles surrounding a central exciting source, rather than to some more exotic mechanism. It has been found that the infrared spectrum cannot be adequately described by a single dust shell model, but is well represented by a two-shell model. (auth)

3589 INFRARED PHOTOMETRY OF R CORONAE BOREALIS TYPE VARIABLES AND RELATED OBJECTS. Feast, M. W.; Glass, I. S. (Radcliffe Observatory, Pretoria). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 293-303(1973).

Infrared photometry (J,H,K,L) is given for 12 RCB stars, three HdC stars, and two helium stars. N,Q observations are given for six of the RCB stars. Most of the RCB stars show infrared excesses. Although the HdC and helium stars are related spectroscopically to the RCB stars they do not show IR excesses. Evidently the occurrence of an IR excess is intimately connected with the RCB phenomenon rather than being a general property of hydrogen deficient, carbon-rich objects. This is understandable if the circumstellar shell is periodically replenished by particles ejected by the variables at minimum. The very hot RCB star, MV Sgr has an IR excess which indicates a hotter shell (1200 to 1500°) than that found in other RCB stars (800 to 900°). V348 Sgr, a peculiar carbon-rich hydrogen-poor variable, has a large infrared excess. This strengthens its similarity to the RCB stars. Recently proposed models for the RCB phenomenon are considered. Ejection of particles at minima rather than geometrical eclipses by circumstellar dust blotches seems required by these observations. (auth)

3590 STUDY OF THE RADIO CONTINUUM SPECTRA OF PLANETARY NEBULAE. Higgs, L. A. (National Research Council of Canada, Ottawa). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 313-330(1973).

Model radio spectra have been fitted to all observational radio data on planetary nebulae known to the author in 1971. From the two parameters of the fitted spectra, electron temperature and optical depth at 10 GHz, values of emission measure, electron density, nebular radius, distance and extinction at Hα and at Hβ, have been derived for ~140 nebulae. These results, along with the tabulated basic radio and optical data, have been published elsewhere in catalogue form. In the present work, the analysis is outlined and a general survey of the detailed results is presented. Tables of nebulae having extreme values of the derived parameters are given. All results of this study are in good agreement with similar results obtained from optical studies of planetary nebulae. In addition, little evidence is found for non-thermal radio emission from any nebulae or for electron temperatures below 5000 K. (auth)

3591 MULTICOLOUR OBSERVATIONS OF UZ LIBRAE. Wisniewski, W. Z. (Univ. of Arizona, Tucson). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 331-334(1973).

Multicolour observations of the β Lyrae variable, UZ Librae, are presented. Light curves in the UBVRI system are given. The colors show an infrared excess, which is attributed to a third light. (auth)

3592 PULSATION OF ROTATING RR LYRAE STARS. Lungu, N. (Institutul Pedagogic, Oradea, Romania). Stud. Cercet. Astron.; 17: No. 2, 227-233(1972). (In Rumanian).

The variable RR Lyrae stars offer an excellent opportunity to compare theoretical derivations with observational data. In the currently accepted "modern" theory of S. A. Jevakin it is assumed that the pulsation is limited to the surface layer with a thickness of about one-tenth of the radius of the star. A model was derived on the basis of a variable star consisting of a stable nucleus and a homogeneous surface layer, having the form of a rotational ellipsoid, and a slow rate of rotation. The gravitational effects and the changes of the gravitational field on the surface were neglected; it was assumed that the radial adiabatic oscillations were small, the energy was transferred by radiation, the energy generated in the nucleus was not affected by the rotation, and the mass distribution in the surface layer was uniform. The pulsation was interpreted by linearizing the equations, comparing the theoretical results with observational data. Study of the effect of the rotation on the period of revolution as a function of mass concentration revealed that the period is shortened. In this connection, the period of Draconis XZ was determined. The calculated value was 0.4743 day while observation yielded 0.4749 day. (TTT)

3593 HYDRODYNAMIC STUDY OF STELLAR CLUSTERS WITH SPHERICAL SYMMETRY. I. Talpaert, Y.; Lefevre, F. (Univ. Libre, Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: No. 6, 759-744(1972). (In French).

A fluid-dynamical method for computing the evolution of a spherical cluster was developed with the help of the spectral equation. The partial derivatives system was closed by introducing a "coefficient d'échange de tensions" expressing the manner by which a fifth order tensions flux influences the fourth order tensions. By this technique, every moment of the velocity distribution up to the fourth order is included contrary to the Larson's method with a nearly Maxwellian velocity distribution. Moreover the use of the equation giving the energy flux variation in the radial direction is straightforward. The collision terms were evaluated from the Fokker–Planck equation using Larson's technique. The partial derivatives system is replaced by a system of finite difference equations. (auth)

3594 MAIN TYPES OF VARIABLE STARS. Flin, P. (Jagellonian Univ., Krakow). Urania (Krakow); 43: 98-106 (1972). (In Polish).

A survey of the properties and classification of variable stars is given. The types of pulsating, eruptive (novae and nova-like), and eclipsing variables are subdivided, and pecularities of different classes are characterized. (auth) (NSA of Poland)

3595 EVOLUTION OF SINGLE STARS. VI. Model Nuclei of Planetary Nebulae. Paczynski, B. (Inst. of Astronomy, Warsaw). Acta Astron.; 21: 417-435(1971).

Model evolutionary computations are presented for Population I ($X_0 = 0.7$, $Z = 0.03$) stars of 0.6, 0.8, and 1 to 2 M_0. Each model consists of a degenerate carbon–oxygen core, helium and hydrogen burning shell sources, and a low-mass hydrogen rich envelope. These models evolve from right to left on the H–R diagram because matter flows from their envelopes through the shell sources into their cores. Superposed on this evolution there are loops caused by the thermal pulses within helium burning shell sources. Finally the available nuclear fuel becomes exhausted and models cool down to the white-dwarf stage. Neutrino energy losses are included in the computations. The initial model for every evolutionary sequence presented was obtained from a model red supergiant stripped of most of its hydrogen-rich envelope. These evolutionary sequences are believed to correspond to the evolutionary patterns of nuclei of planetary nebulae. The brightest and the youngest nuclei should be in a double shell source burning phase. Because of thermal pulses these stars are likely to heat up and cool down a number of times during the evolution. As a result a given planetary nebula may be ionized repeatedly during its lifetime. (auth) (NSA of Poland)

3596 UBV PHOTOMETRY OF THE β CEPHEI TYPE VARIABLE STARS. III. KP Persei (HD 21803). Jerzykiewicz, M. (Univ., Worclaw). Acta Astron.; 21: 501-515(1971).

Eight B and five UBV light curves of KP Persei are presented. Times of maximum light, mean UBV magnitudes, and light-ranges are determined numerically from the light curves. The minor fluctuation reported by Klock (1965) is the extra light seen at the shoulder of the 100-minute light curve and the systems brightness at minimum. This overall trend can be interpreted within a simple model which attributes the observed variations to the variable dimensions of the disk surrounding the primary component. Variability of the physical properties of the disk and of the spot (formed where the stream from the secondary component collides with the disk and responsible for the shoulder) may, however, be of considerable importance particularly when the system is faint and are necessary to explain the occasional disappearance of the shoulder. (auth) (NSA of Poland)

3597 PRELIMINARY RESULTS OF ULTRAVIOLET SPECTROPHOTOMETRIC MEASUREMENTS WITH THE TD-1A SATELLITE. Barker, P.; Boksenberg, A.; Butler, H. E.; Gardier, S.; Houziaux, L.; Humphries, C.; Jamar, C.; Macau-Hercot, D.; Malaise, D.; Monfils, A.; Nandy, K.; Thompson, G. I.; Wilson, R.; Wroe, H. (Culham Lab., Abingdon, Eng.). Compt. Rend., Ser. B; 276: No. 5, 199-202(29 Jan 1973). (In French).

The instrumentation on board the ESRO TD-1A satellite is described and the preliminary results obtained during the first weeks of the flight are presented. Comparisons are made with previous results and theoretical models. (FR)

3598 ECLIPSING BINARY STARS. Flin, P. (Jagellonian Univ., Krakow). Urania (Krakow); 43: 140-144(1972). (In Polish).

General properties of binary systems are discussed for various geometric arrangements. Changes of the light curve for an Algol-type eclipsing star are presented. (auth)

3599 PHOTOELECTRIC OBSERVATIONS OF FLARE STARS. II. Cristaldi, S.; Rodono, M. (Catania Astrophysical Observa-

tory, Italy). Astron. Astrophys., Suppl. Ser.; 10: No. 1, 47-104 (Apr 1973).

The results of a second series of photoelectric observations of UV Cet-type flare stars carried out at the Catania Astrophysical Observatory during 1969 and 1970 are given. The observations refer to the following stars: YZ CMi, UV Cet, BY Dra, EV Lac, Ad Leo, PZ Mon, EQ Peg, V 1216 Sgr, BD + 13°2618 and BD + 55°1823. With respect to the first series of observations (Cristaldi and Rodonò 1970), the present one includes also simultaneous UBV observations made with a synchronous three-color photometer (Cristaldi and Paternò 1969; Paternò 1970) now operating at the Observatory. (auth)

3600 STUDY OF THE OPEN CLUSTER NGC 1778. Barbon, R.; Hassan, S. M. (Asiago Astrophysical Observatory, Italy). Astron. Astrophys., Suppl. Ser.; 10: No. 1, 1-10(Apr 1973).

Magnitudes and colors in the UBV system, based on a combination of photoelectric and photographic photometry, were determined for 114 stars in the open cluster NGC 1778. The color excess was 0.33m and the distance to the cluster 1670 pc. The age was estimated to 1.5×10^8 years. Ten bright stars in the region of the cluster were observed spectroscopically, among which three could be identified as Be stars. (auth)

3601 PURELY INTERNAL GEODESIC MOTION AND RESULTING NECESSARY CONDITIONS FOR RELATIVISTIC SPHERES. Kuchowicz, B. (Univ., Warsaw). Acta Phys. Pol.; B4: No. 2, 291-294(1973).

The study of geodesic motion in internal gravitational fields is of relevance for neutrino emission processes in advanced evolutionary stages of superdense stars. From a general formula for neutrino trajectory in a static field of spherical symmetry certain conditions for the metric are derived in the case when trapped neutrino trajectories are allowed. (auth)

3602 RADIO EMISSION FROM THE CLOSE BINARY b PERSEI. Hjellming, R. M.; Wade, C. M. (National Radio Astronomy Observatory, Green Bank, WV). Nature (London); 242: No. 5395, 250(23 Mar 1973).

The detection of faint intermittent radio emission from the close binary star b Persei is reported using the NRAO interferometer at spacings of 900, 1800, and 2700 m. Concurrent observations were made at 2695 and 8085 MHz. The observations were made during the first half of 1972. Flux densities are given. The radiation showed flare-like variability, and greater strength towards shorter wavelengths. X-ray emission was not observed. It is tempting to suspect that the radio emission is related in some way to binary mass exchange phenomena. (UK)

3603 ONE POSSIBLE MECHANISM OF DECAY OF A GRAVITATIONAL SYSTEM. Omarov, T. B. (Inst. of Physics and Mathematics, Alma-Ata, USSR). Vestn. Akad. Nauk Kaz. SSR; No. 7, 55-61(Jul 1972). (In Russian).

The development of a state of decay in a multiple star system as a result of the ejection of matter at a given rate is discussed. A numerical problem is worked out using as an example a certain multiple star in the Trapezium of Orion. (KSW)

3604 LATE STAGES OF STELLAR EVOLUTION. Paczynski, B. (Zaklad Astronomii, Warsaw). Postepy Astron.; 21: No. 1, 9-24(Mar 1973). (In Polish).

Evolutionary phases following the exhaustion of helium in the stellar cores are discussed. The models of red giants with hydrogen and helium shell sources and their relevance to the problem of formation of planetary nebulae is considered. The problem of carbon ignition or detonation in degenerate carbon cores and its relevance to the supernova explosions and the origin of pulsars is discussed. (auth)

3605 PHOTOELECTRIC OBSERVATIONS OF THE ECLIPSING VARIABLE AI DRACONIS. Winiarski, M. (Jagellonian Univ., Krakow). Acta Astron.; 21: 517-527(1971).

Results of B and V photoelectric observations of the eclipsing binary AI Draconis are presented. The light curve based on the normal points is given along with the improved photometric elements and the (O−C) diagram. (auth)

3606 PHOTOMETRIC PROXIMITY EFFECTS IN CLOSE BINARY SYSTEMS. V. The Average Brightness Weighted Values of Gravity and Effective Temperature for Stars Filling the Roche Lobes. Rucinski, S. M. (Univ. of Florida, Gainesville). Acta Astron.; 21: 455-466(1971).

The average values of gravity and effective temperature for the outer parts of the star (opposite to the companion) are related in a similar way as the local values of these quantities. Variations of these averages with phase depend on the mass ratio, the inclination, and the effective temperature; their magnitude can be predicted. If the reflection effect can be neglected the average gravities on the inner and outer side of the star are almost the same. (auth)

3607 THEORY OF LEVEL SURFACES INSIDE RELATIVISTIC, ROTATING STARS. I. Poincare's Limit. Abramowicz, M. A. (Inst. of Astronomy, Warsaw). Acta Astron.; 21: 449-454(1971).

In 1902 Poincare proved that the maximum value of the angular velocity of rigid rotation of any stationary star can not be greater than $\Omega crit = 2\pi k \bar{\rho}$. One can show that there is a similar, but different limit in the more general case of differential rotation. It is shown that there exist both analogical conditions in general relativity. Both in the general relativity and in the Newtonian theory violation of these conditions implies a continuous increase of the rate of expansion of a star. (auth)

3608 RADIO EMISSION NEBULAE SURROUNDING MWC 349 AND RY SCUTI. Hjellming, R. M.; Blankenship, L. C.; Balick, B. (National Radio Astronomy Observatory, Green Bank, WV). Nature (London) Phys. Sci.; 242: No. 119, 84-85(9 Apr 1973).

Radio emission associated with the stars MWC 349 and RY Scuti has recently been reported, and observations are presented that show that the radio emission from these sources is a consequence of resolvable radio nebulosities with thermal radio spectra. The observations were made with the NRAO interferometer at 2695 and 8085 MHz, and the results indicated that the radio emission arises from compact ($\lesssim$3 arc s) regions surrounding each star. Estimated source fluxes are given, together with the radio spectrum of MWC 349. Except for a possible variable component in MWC 349 both sources show radio characteristics that might be expected for a compact planetary nebula with electron temperatures of the order of 10^4K and dominant emission measures of the order of 10^8 pc cm^{-6}. Some observations are included on the terminology of "radio stars." (UK)

3609 FINITE-AMPLITUDE CONVECTION UNDER THE COMBINED EFFECT OF ROTATION AND A MAGNETIC FIELD. Murphy, J. O.; Van der Borght, R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 3, 147-148(Oct 1972).

The combined effect of rotation and magnetic field at times enhances convection. It is possible for two values of the horizontal wave number to exist for which the Nusselt number has a maximum. (AT)

3610 EVOLUTION OF STARS TO THE WHITE DWARF STAGE. Wegner, G. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 3, 153-154(Oct 1972).

White dwarf masses are estimated from the Chandrasekhar mass–radius relation and gravitational redshifts. Ages of bright stars were determined from isochrones in the HR diagram of Sandage and Eygen. (AT)

3611 DUST SHELL MODELS FOR INFRARED SOURCES. Hyland, A. R.; Gingold, R. A. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 3, 155-156(Oct 1972).

Energy distributions were computed for 89 Her, RY Sgr, VY CMa, and IRC-10381. Quality of agreement with observed results is good but worsens at shorter wavelengths. (AT)

3612 TEMPERATURE AND CONTINUUM OF THE N STARS. Bessell, M. S.; Youngbom, L. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 3, 154-155(Oct 1972).

Red continua of typical M and N stars are compared. The energy distribution of an M5 star, HD 99448, is compared with carbon star V Crucis. (AT)

3613 DEPENDENCE OF FLARE DECAY RATES ON FLARE LUMINOSITIES FOR UV Cet STARS. Gershberg, R. E.; Shakhovskaya, N. I. (Crimean Astrophysical Observatory, Simferopol, USSR). Nature (London) Phys. Sci.; 242: No. 119, 85-86(9 Apr 1973).

It is stated that on the descendent branch of typical light curves of UV Cet-type star flares a fast decay stage can usually be distinguished beginning just after flare maximum, followed by a slow decay stage. The dependence of flare decay rates for both stages on flare luminosities at maxima was studied by Shakhovskaya (Izv. Crimean Astrophys. Obs. Vol. 50 (in press)), and the present communication described an analysis of observations on 13 UV Cet flare stars made at the Crimean Astrophysical Observatory during 1969 to 1972 using the 64 cm. meniscus telescope with a photometric system. Statistical relationships were found between flare luminosities at maxima and flare decay rates. It was also found that for the slow decay stage the decay rate, expressed in stellar magnitude per minute, decreases for brighter stars. (UK)

3614 SUPERSONIC CONVECTION AND THE STRUCTURE OF T-TAURI STARS. Prentice, A. J. R. (Monash Univ., Clayton, Australia). Proc. Astron. Soc. Aust.; 2: No. 3, 152-153(Oct 1972).

An explanation within the evolutionary interpretation is given for the rapid and irregular light variations and material ejection by T-Tauri stars. (AT)

3615 WOLF-RAYET ECLIPSING BINARY CQ CEPHEI IN MONOCHROMATIC EMISSIONS AND THE CONTINUUM. Khaliullin, Kh. F. (Astronomical Inst., Moscow). Sov Astron. AJ (Engl. Transl.); 16: No. 4, 636-642(1973).

Translated from Astron. Zh.; 49: No. 4, 777-785(1972).

Averaged narrow-band light curves are presented for CQ Cep at λ 4795 ($\Delta\lambda \approx 90$ Å, continuum), λ 4686 ($\Delta\lambda \approx 90$ Å, He II emission), λ 6320 ($\Delta\lambda \approx 150$ Å, continuum), and λ 6563 ($\Delta\lambda \approx 150$ Å, He II and Hα emission). The intensities of the λλ 4686 and 6563 emission features vary in antiphase with the neighboring continuum, reaching maximum at conjunction and minimum at elongation. The following interpretation of the effect is suggested: Upon the emission "proper" there is superimposed an invisible absorption of quasiconstant equivalent width, formed in a compact, selectively absorbing envelope surrounding both the O and WN component. The emission "proper" is formed in an extended envelope that remains practically uneclipsed. As the continuum level drops during eclipse, the emission "proper" appears to "float up" above the continuum, so that the visible emission intensity is enhanced. A preliminary decision is reached regarding stratification in the absorbing envelope: The He II absorption zone is located beneath the hydrogen zone. Certain observational data for V444 Cygni are discussed qualitatively on the basis of the model proposed for CQ Cep, illustrating the case of well-separated Wolf-Rayet eclipsing binary systems. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 3666.

3616 (N-73-10852) VLBI OBSERVATIONS OF THE CRAB NEBULA PULSAR. Vandenberg, N. R.; Clark, T. A.; Erickson, W. C.; Resch, G. M.; Broderick, J. J.; Payne, R. G.; Knowles, S. H.; Youmans, A. B. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Oct 1972. 16p. (NASA-TM-X-66071; X-693-72-381). NTIS.

Observations were made at meter wavelengths using very long base-line interferometry techniques. At 196.5 MHz no resolution of the pulsar is observed; all the pulse shapes observed with the interferometers are similar to single-dish profiles, and all the power pulsates. At 111.5 MHz besides the pulsing power there is always a steady component, presumably due to interstellar scattering. The pulsar is slightly resolved at 111.5 MHz with an apparent angular diameter of 0.07 sec ± 0.01 sec. A 50% linear polarization of the time-averaged power is noted at 196.5 MHz; at 111.5 MHz, 20% of the total time-averaged power is polarized, 35% of the pulsing power is polarized, and the steady component is unpolarized. (auth) (STAR)

3617 SEARCH FOR OPTICAL PULSARS. Nelson, M. R. Princeton, NJ; Princeton Univ. (1972). 111p. University Microfilms Order No. 73-9634.

Thesis (Ph. D.).

Using on-line digital techniques at the Princeton 36″ telescope, time series were obtained on pulsar candidates drawn from five classes: single-line binary stars with anomalously heavy unseen companions (10 examples), recent novas (3), x-ray sources (4), extragalactic supernovas (1), and supernova remnants (1). The data were examined through autocorrelation and power spectrum techniques for both narrow- and wide-band features. The analysis scheme and related mathematical techniques are discussed in some detail. Minimum bandwidths range from .002 Hz to .0005 Hz, while the maximum frequency varies from 500 Hz to 5000 Hz. The computed sensitivity of the system was validated by observation of the Crab Nebula pulsar. With this exception, no pulsation was detected down to the limits which are reported. (Diss. Abstr. Int., B)

3618 HIGH-SPEED UBV PHOTOMETRY OF SCORPIUS X-1 FLARES. Moffett, T. J.; Grupsmith, G.; Vanden Bout, P. A. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 85: No. 504, 177-178(Apr 1973).

High-speed UBV observations of Sco X-1 during flare activity reveal that the color indices (B-V) and (U-B) change little if at all during a flare. This indicates that the mechanism responsible for flaring is essentially the same as that governing more gradual intensity changes. (auth)

3619 LIST OF QUASI-STELLAR RADIO SOURCES AND QUASI-STELLAR RADIO-SOURCE CANDIDATES FROM THE 3C AND 4C CATALOGS BETWEEN DECLINATION -7° AND +40°. Agnew, D.; Arp, H. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 85: No. 504, 162-173(Apr 1973).

A list of all 3C and 4C radio sources between declinations -7° and +40° identified by various works is tabulated. This list of 225 objects provides a large and homogeneous sample of QSS and includes a brief description of their observed characteristics. (auth)

3620 SURVEY OF THE RADIO BACKGROUND AT 38 MHz. Milogradov-Turin, J.; Smith, F. G. (Univ., Belgrade). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 269-279(1973).

The Jodrell Bank Mark I radio telescope has been used to survey the northern sky at a frequency of 38 MHz, with a beamwidth of 7.5°. The map is intended for comparisons of the spectral indices of various features of galactic radio emission. (auth)

3621 PULSE ENERGY DISTRIBUTION IN PULSARS. Smith, F. G. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 9P-10P(1973).

The histograms of pulse energy for three pulsars show that each histogram is precisely repeatable, but that they differ markedly between different pulsars. The characteristic shapes and repeatability of these histograms show that the coherence of the emission process does not vary randomly. (auth)

3622 SEARCH FOR THE CYGNUS X-3 INFRARED CANDIDATE AT ONE MICRON. Gaustad, J. E.; Margon, B. (Univ. of California, Berkeley). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 15P-17P(1973).

An attempt to observe the recently discovered infrared candidate for Cygnus X-3 at one micron has yielded the limit I > 16.3. For a typical O9 star, this implies A_v >17.1, probably excluding membership of Cygnus X-3 in the Cyg OB2 association. (auth)

3623 OBSERVATIONAL ASPECTS OF BLACK HOLES. Krygier, B.; Krempec, J. (Instytut Astronimmi, Torun, Poland). Postepy Astron.; 21: No. 1, 37-52(Mar 1973). (In Polish).

The possibility of existence of the black holes in elliptic and spiral galaxies, in globular clusters, and binary stellar systems is described. Individual cases are discussed in detail with emphasis on the possibility of detection. (auth)

3624 HARD X-RAY SPECTRUM PRODUCED BY THERMAL BREMSSTRAHLUNG. Juchniewicz, J. (Univ., Warsaw). Acta Astron.; 21: 479-485(1971).

The importance of relativistic corrections for the hard x-ray spectrum of a weakly relativistic plasma is pointed out. (auth)

3625 CULGOORA-1 LIST OF RADIO SOURCE MEASUREMENTS AT 80 MHz. Slee, O. B.; Higgins, C. S. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys., Astrophys. Suppl.; No. 27, 1-43(Feb 1973).

The Culgoora radioheliograph operating at 80 MHz was used to observe 999 radio sources selected from published catalogues and distributed over the declination range -48° to +35°. The Culgoora-1 list contains measurements with 3.7′ arc resolution of positions, flux densities, and angular sizes of 777 sources, while upper limits to the flux densities of 222 undetected sources are given in a separate list. Success rates for the detection of various classes of radio source at 80 MHz are listed and discussed. Comparisons are made between the Culgoora flux densities and those given in other catalogues, and it is shown that unresolved sources in the earlier low-resolution measurements near 80 MHz cause the flux density to be systematically overestimated. (auth)

3626 OBSERVATIONS OF FORMAMIDE AT 6 CM IN SAGITTARIUS B2. Ribes, J. C.; Ables, J. G.; Godfrey, P. D.; Brown, R. D. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys.; 26: No. 1, 79-84 (Feb 1973).

Six hyperfine components of the $2_{12}-2_{11}$ transition of formamide (NH_2CHO) were measured in the laboratory. The multiplet was subsequently observed in emission in the direction of SgrB2 with the 64 m telescope at Parkes. The relative frequencies and intensities of the three strongest components in the hyperfine structure were in excellent agreement with the laboratory measurement. Their Doppler shift corresponded to a radial velocity of 62 km s^{-1}. (auth)

3627 DECAMETRIC PULSE RADIOEMISSION FROM PSR 0809, PSR 1133, AND PSR 1919. Bruck, Yu. M.; Ustimenko, B. Yu. (Inst. of Radio Physics and Electronics, Kharkov). Nature (London) Phys. Sci.; 242: No. 117, 58-59(26 Mar 1973).

It is stated that reception of decametric radiation from pulsars is extremely hindered by deterioration of the signal-to-noise ratio

in this band caused by a decrease in the pulsar's bandwidth and the high values of the background temperature. Earlier observations and those here reported show the possibility, however, of receiving pulsed signals from some pulsars. The observations described were made at 25 MHz using the N–S arm of the new T-shaped radio telescope of the Ukr. IRE. Receiving facilities consisted of 16 receivers with independent frequency control and independently regulated i.f. bandwidths. Details are given of the signal storage and processing systems, and the program of pulsar observations has been carried out since September 1972. Pulsed signals have been received from PSR 0809, 1133, and 1919. Peak values of the radiation flux reached 20 to 50 fu. A great variety was observed in the mean amplitude and shape of pulses, with rapid transitions from one shape to another, and in a number of cases two or even three pulses could be observed instead of one. The effects become more pronounced with decrease in observation frequency. (UK)

3628 WOLF–RAYET SYSTEMS AND THE ORIGIN OF MASSIVE X-RAY BINARIES. van den Heuvel, E. P. J. (Univ., Brussels). Nature (London) Phys. Sci.; 242: No. 118, 71-72 (2 Apr 1973).

So far four strong x-ray sources have been identified with early type stars, probably all of binary nature, and a fifth (Cen X-3) is also a massive binary. Basic parameters of these five systems are listed, and their probable origin is discussed. It is suggested that during a part of their life the ancestors of these systems are likely to have been Wolf–Rayet binaries. Massive close binaries directly after the first stage of mass exchange are most probably WR binaries, and in such binaries the WR star is always the less massive component, and its luminosity and effective temperature are very similar to those of a He star of the same mass. The observed system parameters of the x-ray binaries listed agree with those expected to result from the evolution of some well known WR binaries. It is concluded that the system parameters of massive x-ray binaries and of short period WR binaries support the hypothesis that these two types of systems represent different stages of evolution of the same kind of objects. (UK)

3629 OBSERVATIONS AT 11 CM OF RECENTLY DISCOVERED PULSARS. Graham, D.; Hunt, G. C. (Max-Planck Institut fuer Radioastronomie, Bonn). Nature (London) Phys. Sci.; 242: No. 119, 86-87 (9 Apr 1973).

The 100m telescope at Effelsberg was used to determine more accurate positions and periods for seven recently discovered pulsars, using a He-cooled parametric receiver at 11 cm. These pulsars were PSR 0355, 0540, 0611, 1112, 2148, 2256, and 2319, and the results are shown tabulated. Amongst other things the strong variability of PSR 0355 was confirmed, and during active periods this is one of the strongest pulsars at this wavelength. The association of PSR 0611 with the supernova remnant IC 443 was also further strengthened. (UK)

3630 WESTERBORK AND EFFELSBERG OBSERVATIONS OF CYGNUS X3. Braes, L. L. E.; Miley, G. K.; Shane, W. W.; Baars, J. W. M.; Goss, W. M. (Leiden Observatory). Nature (London) Phys. Sci.; 242: No. 118, 66-69 (2 Apr 1973).

Extensive radio observations during September and October 1972 showed the behaviour of the Cyg X-3 outburst at 1.4 and 2.7 GHz. Neutral hydrogen absorption measurements place a lower limit of 10 ± 1.5 kpc on the distance of the radio source. No pulsations were detected. (UK)

3631 VARIATION IN THE POLARIZATION ACROSS BENDS IN THE SPECTRA OF SELF-ABSORBED SYNCHROTRON SOURCES. Melrose, D. B. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 3, 140-142 (Oct 1972).

Results of calculations relating to the variation of degrees of polarization with frequency as a homogeneous radio source becomes optically thick, are presented. (AT)

3632 RADIO OBSERVATIONS OF THE GUM NEBULA BELOW 20 MHz. Ellis, G. R. A. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 3, 158-159 (Oct 1972).

Contour diagrams and spectra are presented on the flux density averaged to a revolution of 11° in declination and 3° in RA centered on l = 262°, b = −5°. (AT)

Solar Phenomena

Refer also to abstracts 3560, 3686, and 4050.

3633 (NP-19727) ISOTOPIC COMPOSITION OF SOME METALS IN THE SUN. Hauge, Oe. (Oslo Univ. (Norway). Institutt for Teoretisk Astrofysikk). 1972. 76p. Dep. NTIS (U. S. Sales Only) $6.00.

Thesis.

Information on the isotopic composition of chemical elements in the Sun may be obtained by analysis of photospheric and sunspot spectra. It is shown that besides investigations performed on molecular lines, information on isotope abundances of some heavier elements may also be derived from atomic line studies. A discussion of the elements Rb, Sr, Sb, and Eu are described. Studies of the solar isotopic composition of Cu from analysis of Cu I lines in photospheric spectra and CuH lines in sunspot spectra are described. The results obtained are: $^{63}Cu/^{65}Cu = (70 \pm 7)/(30 \mp 7)$; $-^{85}Rb/^{87}Rb = (73 \pm 4)/(27 \mp 4)$; $-^{151}Eu/^{153}Eu = (52 \pm 6)/(48 \mp 6)$; $-^{87}Sr/Sr \leq 0.25$. No conclusions could be drawn about isotopes of Sb in the Sun. Although the results may indicate a solar overabundance of ^{151}Eu as compared with terrestrial composition, the investigations provide no proof of nonterrestrial isotope ratios in the Sun of any of the elements listed. The abundances of Rb, Sr, and Eu were determined and the results agree closely with previously determined values. (auth)

3634 SPATIAL DISTRIBUTION OF EMERGING FLUX REGIONS. Glackin, D. L. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 85: No. 504, 241-248 (Apr 1973).

The absence of preferential longitudes for emerging flux regions (EFRs) on the Sun indicates that sunspot preferential longitudes, if they exist, are due to favorable longitudes for EFRs to become spot groups rather than to the distribution of points of emergence of EFRs. A short-lived "preferential latitude" (classical activity complex) is found. The latitudinal distribution of all EFRs exhibits a Maunders diagram behavior as expected on the basis of data for the fraction of EFRs which become spot groups. Possibly significant nonrandom behavior of the EFR time distribution is also found. (auth)

3635 ADDITIONAL EVIDENCE FOR THE EXISTENCE OF A VERY HIGH ENERGY SOLAR PARTICLE COMPONENT. Schindler, S. N.; Kearney, P. D. (Colorado State Univ., Fort Collins). Nature (London) Phys. Sci.; 242: No. 117, 56-57 (26 Mar 1973).

A statistical analysis was made of data obtained during 1971 to 1972 from the Colorado underground solar cosmic-ray experiment, and attention is drawn to an apparently significant trend in the results. The purpose was to establish further the existence of a very high-energy flare-generated particle flux, beyond the past limits set by the vertical geomagnetic cut-off (~15 GeV), resulting in an extension of the flare particle spectrum into this region. The analysis was directed towards uncovering a possible small average enhancement associated with specific flare groups. The technique employed was superposition of epochs. (UK)

3636 EXTREME ULTRAVIOLET LINE INTENSITIES FROM THE SUN. Woodgate, B. E.; Knight, D. E.; Uribe, R.; Sheather, P.; Bowles, J.; Nettleship, R. (University Coll., London). Proc. Roy. Soc. (London), Ser. A; 332: No. 1590, 291-309 (27 Mar 1973).

An extreme ultraviolet spectrometer experiment by University College London for observation of whole-Sun spectrum-line fluxes, and flown on Orbiting Solar Observatory-6, is described. Results for the four lines with absolute calibration are shown for the first 6 months of flight, from August 1969 to February 1970. The mean fluxes for the 30.4, 53.7, 58.4, and 121.6 nm lines are $8.1 \times 10^9 \pm 35\%$ ph cm^{-2} s^{-1}, $3.2 \times 10^8 \pm 40\%$ ph cm^{-2} s^{-1}, $2.5 \times 10^9 \pm 40\%$ ph cm^{-2} s^{-1}, and $3 \times 10^{11} \pm 50\%$ ph cm^{-2} s^{-1}, respectively. Relations between these fluxes and the 10.7 cm radio flux and Zurich sunspot number are presented. (auth)

3637 HARMONIC STRUCTURE IN A SOLAR TYPE V BURST. Benz, A. O. (Eidgenoessische Technische Hochschule, Zurich). Nature (London) Phys. Sci.; 242: No. 116, 38-39 (19 Mar 1973).

It is thought that harmonic structure would be observable, at least sporadically, in the spectra of Type V solar bursts. The observation of such structure with the new spectrographic at Zurich is reported. A sudden explosive flare occurred on October 25, 1972. The radio event received by the spectrograph started with a group of Type III bursts centered around 450 MHz, followed by an extremely strong continuum for about 30 s, with a range from 400 to 154 MHz (instrumental limit). A maximum of 10^{-18} W/m^2/Hz was measured at 287 MHz and more than 1.2×10^{-17} at 234 MHz. The double structure observed at the beginning of the continuum showed a common drift rate of 22.5 MHz/s, which is more than an order of magnitude higher than in Type II bursts, and the morphology of the continuum event required classification as Type V. It was concluded that the Type V burst showed at its beginning a harmonic frequency structure of relation 2:3. This first observation of definite harmonic structure in a Type V burst gives strong support to the theory explaining this type as plasma wave emission. (UK)

3638 SOLAR MICROWAVE BURSTS AND POLAR CAP ABSORPTION. Croom, D. L. (Science Research Council, Slough, Eng.). Planet. Space Sci.; 21: No. 4, 707-709(Apr 1973).

In a series of earlier papers by Croom (Astrophys. Lett.; 7: 133(1970), J. Geophys. Res.; 75: 6940(1970), Solar Phys.; 19: 152(1971) and Solar Phys.; 19: 171(1971)) attention was drawn to the use of impulsive single-frequency microwave bursts for providing warnings of the occurrence and intensity of solar proton events as measured by satellites in the vicinity of the Earth. Similarly, a general relation between the duration of Type IV events, particularly those associated with microwave bursts, was recognized qualitatively many years ago (Pick-Gutmann, M., Annls. d'Astrophys.; 24: 183(1961) and Bell, B., Smithson. Contr. Astrophys.; 5: 239(1963) and 8: 119(1963)). This note extends this work to the quantitative relation between the mean duration T_M of microwave-millimeter wave bursts and the intensity of polar cap absorption (PCA) events. (auth)

3639 VARIATION OF THE CORONAL LAMBDA 5303 INTENSITY RELATIVE TO THE INTERPLANETARY AND SOLAR MAGNETIC SECTOR STRUCTURE, AND TO GEOMAGNETIC ACTIVITY. Gulbrandsen, A. (Norwegian Inst. of Cosmic Physics, Oslo). Planet. Space Sci.; 21: No. 4, 703-707(Apr 1973).

An analysis on the variation of coronal λ 7303 intensity relative to the solar magnetic sector boundaries is presented. The location of the boundaries has been extrapolated from the observed interplanetary sector structure. The results indicate that in the years 1962 to 1964 the solar activity is in general high to the west and low to the east of a solar sector boundary. Such a distribution of solar activity contradicts the one assumed up to now. Nevertheless, this distribution is in general in agreement with results of investigations on the correlation between solar and geomagnetic activity. (auth)

3640 HIGH-DISPERSION SPECTRUM 6610 A TO 6770 A OF A LARGE SUNSPOT. Engvold, O. (Univ. of Oslo). Astron. Astrophys., Suppl. Ser.; 10: No. 1, 11-45(Apr 1973).

A high dispersion spectrum (8.5 mm/Å) in the range 6610 to 6770Å of a large sunspot (Roma No 5367) was recorded photographically at Oslo Solar Observatory. Nearly simultaneous broad band observations of umbral/photospheric contrast and drift curves across the solar limb were made in the same spectral region using a pinhole photometer. The umbral/photospheric continuum contrast corrected for parasitic light in the umbra was found to be 0.106 ± 0.016 in this spectral range for this particular sunspot. The intensity profile of the umbral line spectrum is presented (corrected for parasitic light). A total of 1649 umbral lines were detected within the observed spectral range. Of these 1256 lines from the TiO molecule, 2 lines of CaH, and 14 atomic lines were found. The wavelengths and central intensities of umbral lines are tabulated. (auth)

3641 EFFECTS OF BOUNDARY CONDITION ASYMMETRIES ON THE INTERPLANETARY MAGNETIC FIELD–MOON INTERACTION. Reisz, A. C. Paul, D. L.; Madden, T. R. (Massachusetts Inst. of Tech., Cambridge). Moon; 4: No. 1-2, 134-140(Apr 1972).

Boundary condition asymmetries inherent in the solar-wind flow past the Moon are included in a cylindrical model of the interplanetary magnetic field–Moon interaction. Numerical examinations of the sunward side response of this model are compared in the frequency domain with those of symmetrically excited spherical and cylindrical models and two characteristic differences are observed: the response of the asymmetric model is depressed at low frequencies due to magnetic diffusion around a conducting core, and is flattened at high frequencies because of the finite application time of the incident interplanetary magnetic field. The diffusion of field lines around the core is also evident in the time response of the model in the anti-solar cavity. The above features of the lunar response resulting from boundary condition asymmetries are shown to be evident in observational measurements. (auth)

3642 BODE'S LAW. Lecar, M. (Smithsonian Astrophysical Observatory, Cambridge, MA). Nature (London); 242: No. 5396, 318-319(30 Mar 1973).

Reference is made to Ovenden's theory (Nature 239:808 (1972)) which was intended to provide a dynamical explanation for Bode's law. It is suggested that the approximately constant spacing ratio expressed in Bode's mnemonic can be generated by a sequence of random numbers subject to the constraint that adjacent planets cannot be "too close to each other." The physical basis for the constraint is that if in the process of accretion two planets were "too close to each other" they would coalesce and cease to grow because they were competing for the same material. This appears to offer a satisfactory rationalization of Bode's mnemonic. It is further suggested that the closer spacing of the satellite system compared with the spacing of planets in the solar system might be accounted for by the fact that the satellites did not grow to a size where they accreted gas, in addition to dust, and that their accretion was not appreciably helped by their self-gravity; they thus consumed a smaller fraction of their surrounding nebula and could be formed closer together. (UK)

3643 ORIGIN OF THE MOON. Fremlin, J. H. (Univ. of Birmingham, Eng.). Nature (London); 242: No. 5396, 317-318 (30 Mar 1973).

Some doubts are expressed concerning the proposal of Anderson (Nature 239:263 (1972)) that the Moon condensed from material off the median plane of the initial solar nebula. (UK)

3644 OUTER SOLAR SYSTEM. Cameron, A. G. W. (Yeshiva Univ., New York). Science; 180: No. 4087, 701-708(18 May 1973).

An attempt is made to give a concise summary of the status of scientific thinking concerning the outer solar system, as reflected in the reports of the advisory group of the JPL and in the current literature. The outer solar system is considered to begin beyond the asteroid belt. (WDM)

3645 SHOCK WAVES AND THE INTERPRETATION OF THE CHROMOSPHERIC CALCIUM K-LINE. Cram, L. E. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 2: No. 3, 146-147(Oct 1972).

A one-dimensional representation for the bright features at disk centre is used to examine the time variation of the emergent profile as a shock wave passes upwards through the solar atmosphere. (AT)

3646 ELEMENTAL AND ISOTOPIC ABUNDANCES OF THE VOLATILE ELEMENTS IN THE OUTER PLANETS. Cameron, A. G. W. (Yeshiva Univ., New York). Space Sci. Rev.; 14: No. 3-4, 392-400(1973).

Certain fundamental scientific problems of a cosmological as well as cosmogonic character, may be solved by the insertion of entry probes into the atmospheres of the outer planets. It is recommended that attempts be made to determine the elemental and isotopic abundances of H, D, He^3, He^4, C, N, O, S, and the rare gas elements. These determinations should cast much light on the processes which participated in the assembly of the giant planets. This would give powerful boundary conditions on theories of the origin of the solar system, and would also give additional experimental information bearing on cosmology. (auth)

3647 INTERACTION OF THE INTERSTELLAR MEDIUM WITH THE SOLAR WIND. Axford, W. I. (Univ. of California, San Diego, La Jolla). Space Sci. Rev.; 14: No. 3-4, 582-590 (1973).

The possibilities for making observations of the region of interaction between the solar wind and the interstellar medium, and of the interstellar medium itself, are discussed. It is emphasized that missions to the outer planets undertaken in 1977–1979 are ideally suited for making such observations. (auth)

3648 EVIDENCE FOR OBJECTS OF LUNAR MASS IN THE EARLY SOLAR SYSTEM. Urey, H. C. (Univ. of California, San Diego, La Jolla). Moon; 4: No. 3-4, 383-389(1972).

The problem of the accumulation of the Moon is discussed on the assumption that the Moon is a captured object. If it is such, it is highly improbable that it is the only object of this kind present in the early solar system. Evidence indicating that other massive objects were present at that time is presented. Also, it is pointed out that interior of the Moon must contain normal solar proportions of the elements of intermediate volatility in the lunar interior, if the Moon accumulated in a gas sphere. (auth)

3649 RASPREDELENIE ENERGII V SPEKTRE SOLNTSA I SOLNECHNAYA POSTOYANNAYA. (Energy Distribution in the Solar Spectrum and the Solar Constant). Makarova, E. A.; Kharitonov, A. V. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko Matematicheskoi Literatury (1972). 288p.

The flow of energy radiated by the Sun and its spectral components are examined, and a critique of previous investigations is offered. A large number of measurements by various methods has made possible a reliable value for the solar constant, 195 cal/cm^2 · sec, and the energy distribution in the solar spectrum from 1400 Å to 0.3 mm. Apparatus and methodology in these determinations are discussed. (424 references) (KSW)

3650 NUMERICAL METHOD FOR THE INVERSION OF A SINGLE LINE PROFILE. Holt, J. N. (Univ. of Queensland, St. Lucia, Australia). Proc. Astron. Soc. Aust.; 2: No. 3, 150-151 (Oct 1972).

A preliminary note is given on a numerical method used to solve the problem of inverting a single absorption line profile. It is assumed that Sλ(t) is independent of λ, and that the profile has a Voigt shape and is completely determined by the broadening factor and the Doppler width. (AT)

3651 SOLAR WIND IN THE OUTER SOLAR SYSTEM. Montgomery, M. D. (Los Alamos Scientific Lab., N. M.). Space Sci. Rev.; 14: No. 3-4, 559-575(1973).

The properties of the solar wind including magnetic fields, plasma, and plasma waves are briefly reviewed with emphasis on conditions near and beyond the orbit of Jupiter. An extrapolation of the steady-state wind to large distances, evolution of disturbances and structure, modulation of cosmic rays, interactions with planetary bodies (bow shocks and magnetosheaths), and interactions with interstellar neutral helium and hydrogen are briefly discussed. Some comments on instrumentation requirements to observationally define the above phenomena are also included. (auth)

3652 GIANT CELLS AND THE SOLAR CYCLE. Wilson, P. R. (Univ. of Sydney). Proc. Astron. Soc. Aust.; 2: No. 3, 144-146(Oct 1972).

The behavior of uni-polar and bi-polar magnetic regions is discussed in terms of giant cell eddies, sunspots, and granulation. (AT)

3653 INTERPRETATION OF SOLAR RADIO-BURST POSITIONS IN A SCATTERING CORONA. Riddle, A. C. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 3, 148-150(Oct 1972).

Investigations were made to determine a model for solar radio-burst positions in a scattering corona. Refraction effects prohibit radiation from reaching the observer except where the source is near the centre of the solar disc. Bursts are observed for sources anywhere on the disc and it was postulated that this was caused by density inhomogeneities such as a streamer superimposed on a spherically symmetric corona. Radiophysical observations indicated that the electron density model corresponded to a lower streamer density than was originally thought. Maps were drawn at power contours for fundamental and harmonic frequency source bursts. Sources of bursts at intermediate longitudes were not easy to distinguish. (AT)

Galaxies

3654 SELF-CONSISTENT MODELS OF DISC GALAXIES. West, M. L. New York; Columbia Univ. (1970). 134p. University Microfilms Order No. 73-8992.

Thesis (Ph. D.).

Four families of self-consistent gravitational models of disc galaxies were computed numerically, and one representative of each type was compared in detail with observations of stellar and gas dynamics in the Milky Way. These models were developed for a disc of stars which is assumed to be 1) in a steady state, 2) with no collisions between stars, 3) self-gravitating, 4) axisymmetric, and 5) of negligible thickness. The system is then described by the collisionless Boltzmann equation which concerns the distribution function, and by the Poisson equation which relates the gravitational potential to the distribution function. (TSS)

3655 SPIRAL OR FLAT ELLIPTICAL GALAXIES AS GRAVITATIONAL LENSES. Norton, T. D. Jr. Norman, OK; Univ. of Oklahoma (1972). 86p. University Microfilms Order No. 73-9165.

Thesis (Ph. D.).

Flat circular plates of a particular mass density are used to represent spiral or flat elliptical galaxies. The light-bending formulae for such objects are found by assuming that the linearized Einstein theory of general relativity is applicable. The probability of seeing two images of a distant source around one of these objects is then examined and is found to depend upon the intrinsic properties of the galaxy, the orientation of the galaxy with respect to the observer, and upon the overall structure of the Universe. The probability of observing double sources is found to be negligible in a Friedmann cosmological model with a mean mass density corresponding to that of the observed galaxies, but in a model with a mean mass density just sufficient to close the Universe as many as 5% of the sources at redshift, two, may exhibit double images. The brightness and angular separation of the two images is also examined in a Universe whose mean mass density is just sufficient to close it. The brightness of the images is found to be sufficient to allow observation, but the angular separation is found to be marginal as far as observation by optical methods is concerned. (Diss. Abstr. Int., B)

3656 MEASUREMENT OF THE MASS-TO-LIGHT RATIO OF THE COMA CLUSTER OF GALAXIES. Ruddy, V. P. Princeton, NJ; Princeton Univ. (1972). 111p. University Microfilms Order No. 73-9642.

Thesis (Ph. D.).

The luminosity distribution of the Coma Cluster of galaxies was measured photometrically in an effort to reconcile the abnormally high mass-to-light ratio of the cluster (~400) with that of individual galaxies (~50). It was found that (1) the matter was more centrally concentrated and (2) the overall luminosity was over twice as high as previously accepted. Both factors reduced the mass-to-light ratio to ~100, a figure which is near the upper limit of the mass-to-light ratio of individual E and SO galaxies published recently by the Burbidges (1972). (Diss. Abstr. Int., B)

3657 SURFACE PHOTOMETRY OF GALAXIES: COMPARISON OF THE LUMINOSITY PROFILES AND PHOTOMETRIC PARAMETERS OF SOUTHERN GALAXIES MEASURED AT CORDOBA AND MOUNT STROMLO. de Vaucouleurs, G.; Agueero, E. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 85: No. 504, 150-161(Apr 1973).

The equivalent luminosity profiles and main photometric parameters of 14 galaxies in common between the Cordoba Atlas and Mount Stromlo Survey are compared. Systematic and accidental errors are discussed. Total photographic magnitudes based on provisional zero points are transformed to the B system. The relations between photometric effective (half-power) diameters and apparent photographic diameters are derived. The relations between photometric concentration indices and morphological type are illustrated. (auth)

3658 REASSESSMENT OF THE STRUCTURE OF THE SEYFERT GALAXY NGC 4151. Davies, R. D. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 25P-30P(1973).

Twenty-one centimetre neutral hydrogen measurements of NGC 4151 show that the position angle of its major axis is 26 ± 3° rather than the generally adopted value of ~130° derived from the brighter isophotes. Also the inclination is 26 ± 8° which makes it more face-on than previously believed. Neutral hydrogen extends ~9′ arc along the major axis and has a normal surface density for a Sab galaxy in the regions where the outer optical spiral arms are extremely faint. Some implications of these results are discussed. (auth)

3659 HEATING OF INTERSTELLAR CLOUDS BY VIBRATIONALLY EXCITED MOLECULAR HYDROGEN. Stecher, T. P.; Williams, D. A. (Goddard Space Flight Center, Greenbelt, MD). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 305-311(1973).

The possibility is considered that vibrationally excited H_2 may be collisionally de-excited, so providing a heating mechanism for interstellar clouds which operates by coupling the stellar radiation to the gas. The majority of excitations in the Lyman and Werner bands of H_2 return the molecules to the ground electronic state in a vibrationally excited level, the most favoured being $v'' = 7$. The heating rate obtained in this way is compared with other mechanisms which have been postulated, and the results of calculations of temperature as a function of depth into clouds of different densities are presented. It appears that this mechanism is a significant one, which should be taken into account in detailed models of dense clouds. (auth)

3660 DUST IN THE CORE OF THE SMALL MAGELLANIC CLOUD. Martin, W. L.; Thackeray, A. D. Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 5P-8P(1973).

Of 11 stars in the SMC core selected from UBV photometry as possibly reddened early-type stars, four appear to be members, one a Be star. The result is consistent with a normal dust content of the Cloud, but further photometry is desirable. (auth)

3661 RADIO PULSES FROM THE DIRECTION OF THE GALACTIC CENTRE. Hughes, V. A.; Retallack, D. S. (Queen's Univ., Kingston, Ont.). Nature (London); 242: No. 5393, 105-107 (9 Mar 1973).

The results of a new experiment to attempt to correlate radio pulses and gravitational radiation pulses, are described. The results were inconclusive, but there was strong evidence for the existence of discrete radio pulses of extra-terrestrial origin. A 60 ft. telescope operating at 858 MHz was used. In the first stage of the analysis correlation was attempted between data of radio events and gravitational events, and an analysis of the time interval between the radio and gravitational events was carried out; no significant correlation was found, although the results were not statistically significant, and the source of gravitational events could lie outside the radio search area. An attempt was also made to determine the direction of origin of events; there was a slight

trend towards an increase in number received from the direction of the Galactic centre. It was concluded that there might be a discrete source giving consistently larger pulses than average, for the region scanned, and estimated coordinates are given. The question of how the events relate to known radio, optical, infrared, x-ray, and γ-ray sources is discussed. A possibility is that most of the events could be produced by pulsars, and hence could be related to supernova remnants in the Galactic centre region. No correlation was found between the times of occurrence of the radio events and those of solar bursts, solar flares, and sudden ionospheric disturbances. Some of the radio events may have been due to electromagnetic radiation from extensive air showers produced by cosmic rays. Other interesting speculations are that the events might be associated with black holes, and produced either by charged particles falling into them, or by collision of black holes. (UK)

3662 NEW M DWARFS IN THE SOUTH GALACTIC CAP. Jones, D. H. P. Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 19P-24P(1973).

Twenty-two new dwarf M stars are reported. If the M dwarfs are distributed homogeneously in the solar vicinity then the spatial mass density of the present sample is too small to explain the "missing mass" required by stellar dynamics. There is a large uncertainty arising from the small sample size. (auth)

3663 DO THE GALACTIC CLUSTERS ORIGINATE IN AN EXPLOSION. Kuchowicz, B. (Univ., Warsaw). Urania (Krakow); 43: 115-117(1972). (In Polish).

It seems that recent radioastronomical findings are confirming the hypothesis (due to Ambartsumian) of an origin of stellar associations and galaxies in explosive processes. Results of observations on the galaxy cluster in Perseus (by Chincarini and Rood) point in favor of such an interpretation, together with Arp's results, according to which accompanying galaxies situated at the end of spiral arms of normal galaxies have been ejected from the nuclei of the latter ones. Some theoretical problems are briefly discussed. (auth)

3664 LIST OF SUSPECTED CLUSTERS IN THE SOUTHERN MILKY WAY. Loden, L. O. (Astronomical Observatory, Uppsala). Astron. Astrophys., Suppl. Ser.; 10: No. 1, 125-133(Apr 1973).

A list with identification maps is presented of 44 stellar clusterings in the Carina–Centaurus region, which are presumably of physical nature. UBV photometry was performed on a few of the conspicuous members. (auth)

3665 SEARCHES FOR PULSES OF ELECTROMAGNETIC RADIATION FROM THE GALACTIC CENTRE. Jelley, J. V. (Atomic Energy Research Establishment, Harwell, Eng.). Gen. Relativity Gravitation; 4: No. 1, 23-27(Feb 1973).

A network of five widely spaced receivers, operated by four research groups, have been used to search for radio pulses which might have been expected to accompany Weber's Gr-events. No four-fold radio coincidences were observed in 209 hours of observation, at a sensitivity threshold of 2.5×10^{-17} Jm^{-2} per pulse, within a bandwidth of 1 MHz, at 151.5 MHz. (auth)

3666 INFLUENCE OF SELECTION ON THE REDSHIFT DISTRIBUTION OF QUASARS. Semeniuk, I. (Univ., Warsaw); Kruszewski, A. Acta Astron.; 21: 437-447(1971).

It is shown that the observational selection strongly affects the redshift distribution of quasars. The apparent clustering of redshifts around z = 2.0 is most likely spurious. (auth)

3667 RELATIVE NUMBER AND SPACE DISTRIBUTION OF DOUBLE AND MULTIPLE GALAXIES. Zonn, W. (Univ., Warsaw). Acta Astron.; 21: 487-499(1971).

The analysis of two independent counts of single, double, and multiple galaxies on the National Geographic Society–Palomar Observatory Sky Survey maps shows that the mean number of double systems is not a monotonous function of the number N of single galaxies in the same fields. It grows up to N = 50 per square degree and then decreases becoming practically negligible for rich fields. The mean number of multiple systems does not show this peculiarity being an increasing function of N. A tentative explanation of these facts is proposed. (auth)

3668 DETECTION OF INTERSTELLAR THIOFORMALDEHYDE. Sinclair, M. W.; Fourikis, N.; Ribes, J. C.; Robinson, B. J.; Brown, R. D.; Godfrey, P. D. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia). Aust. J. Phys.; 26: No. 1, 85-91(Feb 1973).

The $2_{11} \leftarrow 2_{12}$ transition of thioformaldehyde (HCHS) was observed in absorption in the direction of Sagittarius B2. For a rest frequency of 3139.38 MHz the peak absorption occurred at a radial velocity of 60 ± 4 kms^{-1}. The half-width of the absorption profile was equivalent to 20 kms^{-1} and the column density of HCHS was greater than 10^{16} molecules cm^{-2}. Comparison with the $2_{11} \leftarrow 2_{12}$ absorption of formaldehyde (HCHO) at 15 GHz allowed the relative abundance of the two molecular species to be computed as a function of the rotational excitation temperature. For thermal equilibrium the strength of the $1_{10} - 1_{11}$ absorption in Sgr B2 by thioformaldehyde predicted from the $2_{11} \leftarrow 2_{12}$ HCHS observations was considerably greater than the limits set by a number of observers for the $1_{10} - 1_{11}$ transition at 1046 MHz. (auth)

3669 ANOMALIES IN THE LOW-FREQUENCY RADIO SPECTRA OF SOME BRIGHT GALAXIES. Slee, O. B. (CSIRO, Sydney). Proc. Astron. Soc. Aust.; 2: No. 3, 159-161(Oct 1972).

Radioheliograph measurements were made on 30 bright galaxies at 80 MHz. Flux densities at low frequencies were found to lie between a factor of 2 to 7.5 below the values predicted from extrapolating power law spectra defined by higher frequency measurements (1,000 to 5,000 MHz). (AT)

3670 MASSES OF OLD LMC GLOBULAR CLUSTERS. Freeman, K. C.; Munsuk, C. (Australian National Univ., Canberra). Proc. Astron. Soc. Aust.; 2: No. 3, 151-152(Oct 1972).

Masses for NGC 1835 and NHC 2210 are similar to those for the bright young LMC clusters ($\sim 3 \times 10^4 M_\odot$). NGC 6388 is much more massive and has a much larger M/L ratio. (AT)

Cosmology

Refer also to abstracts 3564, 3655, and 4466.

3671 RADIO SOURCE COUNTS IN COSMOLOGY AND REPLY TO HOYLE. Hoyle, F.; Schmidt, M. (California Inst. of Tech., Pasadena). Nature (London); 242: No. 5393, 108-109(9 Mar 1973).

Comments are offered on objections made by Schmidt (Nature 240: 399(1972)) to arguments used by Hoyle in his 1968 Bakerian Lecture (Proc. Roy. Soc. A., 308: 1(1969)). A reply by Schmidt is appended. (UK)

3672 MEASUREMENT OF THE GRAVITATIONAL DEFLECTION OF RADIO WAVES BY THE SUN DURING 1972 OCTOBER. Riley, J. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 11P-14P(1973).

The deflection of radio waves in the Sun's gravitational field has been measured by observing the radio source 3C 279 before and after its occultation by the Sun in 1972. The observed deflection was 1.05 ± 0.08 times that predicted by general relativity. (auth)

3673 GLOBAL PROPERTIES OF THE PETROV TYPE D VACUUM METRICS IN GENERAL RELATIVITY. Miller, J. G. Princeton, NJ; Princeton Univ. (1972). 101p. University Microfilms Order No. 73-9629.

Thesis (Ph. D.).

All the algebraically special Petrov type D vacuum metrics are known. The Schwarzschild, Kerr, and Taub-NUT solutions of the Einstein vacuum equations are well-known examples of type D metrics. The type D vacuum metrics depend on a few parameters and have an isometry group with dimension ≥2. The metrics with a 2-dimensional isometry group reduce to metrics with a 4-dimensional isometry group when certain parameters are zero. The global properties of the type D vacuum metrics were investigated, maximal analytic extensions of the metrics were constructed, and their singularities are discussed. A type D metric with a 2-dimensional isometry group and its limiting metric with a 4-dimensional isometry group have similar global properties. For simplicity the metrics with a 4-dimensional isometry group are considered. The Lie groups SU(2) and SL(2,R) appear as isometry groups. These groups are also known as the type VIII and IX groups, respectively, in Bianchi's classification of 3-dimensional Lie groups. The orbits of these groups are either 3-dimensional or 2-dimensional submanifolds. Ehlers and Kundt have studied the metrics in which the orbits of these groups are 2-dimensional. These metrics are static in certain regions. The metrics in which the orbits of these groups are 3-dimensional are examined. When the orbits are 3-dimensional and the Lie group is acting on itself by left translations, the metric can be expressed in the global basis of left-invariant 1-forms. This procedure eliminates most of the coordinate singularities. The remaining coordinate singularities are associated with fixed points of certain one-parameter groups of isometries. These singularities are treated by standard techniques based on Boyer's invariant classification of the types of fixed points of a one-parameter group of isometries in a 4-dimensional Lorentz

manifold. In some cases the two procedures for covering all the singularities are globally incompatible. This happens with the singularities in the Taub-NUT metric. (Diss. Abstr. Int., B)

3674 RELATIVISTIC ASTROPHYSICS. Part III. Gravitational Collapse, Singularities, and Black Holes. Lasota, J. P. (Zaklad Astronomii, Warsaw). Postepy Astron.; 21: No. 1, 25-35 (Mar 1973). (In Polish).

Basis of black hole theory and problems related to the existence of singularities are discussed. (auth)

3675 RADIO TESTING OF COSMOLOGICAL MODELS. Part I. Methods of Observation. Urbanik, M. (Jagellonian Univ., Krakow). Postepy Astron.; 20: 3-22(1972). (In Polish).

Radio testing methods of cosmological models are reviewed and the basic observational methods that enable one to form complete samples of radio sources are presented. Such samples constitute basic data for the investigation of the Universe by radio sources counts. (auth)

3676 METHOD FOR CALCULATING THE SPACE–TIME METRIC INSIDE A COLLAPSING EXPANDING SPHERE. Banerji, S. (Dublin Inst. for Advanced Studies). Gen. Relativity Gravitation; 4: No. 1, 13-21(Feb 1973).

A class of solutions of Einstein's field equations is found in which quantities can be expressed as power series in r. Using null coordinates it is shown that the space–time metric inside a spherically symmetric distribution of matter can be calculated to any degree of accuracy by evaluating the terms in the power series step by step, provided the central density, ρ_0, as a function of time, and the equation of state in the form $p = f(\rho)$, $f(\rho)$ being a function analytic at ρ_0, are known. The method is found to be applicable to all cases met with in nature. (auth)

3677 COLLAPSE IN THE SCALAR–TENSOR THEORY OF GRAVITATION. Gorelik, G. E. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 56-60(1973). (In Russian).

A transformation was obtained which connected the static spherical-symmetrical solutions of Heckman and Brans–Dicke. The dimension of the singular region was investigated as a function of the parameter ω. At $\omega > 0$ a test particle would reach the singular surface in finite time. (tr-auth)

3678 METRICS FOR THE STATIC PLANAR-SYMMETRIC SPACE–TIME OF DE SITTER. Prepelitsa, B. V. Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 152-153(1973). (In Russian).

The metrics of the static plane-symmetric space–time constant of curvature were considered, beginning with Einstein's gravitation equation. An equation was derived which describes the static gravitational field in a vacuum, established by a homogeneous plane which is situated in de Sitter space. (KSW)

3679 BLACK HOLES IN STATIC VACUUM SPACE–TIMES. Zum Hagen, H. M.; Robinson, D. C.; Seifert, H. J. (King's Coll., London). Gen. Relativity Gravitation; 4: No. 1, 53-78(Feb 1973).

An extension of Israel's theorem (Phys. Rev.; 164: 1776 (1967) and Comm. Math. Phys.; 8: 245 (1968)) on the regularity of killing horizons is proven. Well behaved asymtotically flat vacuum solutions of the Einstein equations which represent the exterior of a nonrotating black hole are considered. It is shown that the black hole has spherical topology and that the equipotential surfaces g_{00} = constant are nonintersecting two-spheres. The solutions must therefore be members of the one-parameter family of spherically symmetric Schwarzschild solutions. (auth)

3680 ANOTHER TEST OF SPACE–TIME CURVATURE AND RELATIVITY. Grayson, H. W. (Univ. of Hawaii, Honolulu). Nature (London); 242: No. 5396, 317(30 Mar 1973).

It is stated that arising out of Eddington's measurement of space–time curvature by the edge of the Sun, thereby confirming Einstein's forecast, an additional test of relativity is available. Obviously space must be curved through a physical fourth dimension, and the fact that the curvature cannot be seen should not cloud its perception. Light following the curvature must be accelerating, and consequently the intrinsic brightness of starlight must be reduced to an apparent brightness in direct proportion to the distance covered. By looking further and further out into space astronomers should be able to detect a redshift in starlight, increasing in direct proportion to the distance. This test may become feasible when the Hubble 100 inch telescope is in operation. Any three-dimensional interpretation of the redshift must be avoided; such an interpretation could set relativistic physics back many years. Discovery of such a redshift in starlight will provide additional confirmation of Einsteinian space–time curvature and relativity. (UK)

3681 UNDERABUNDANCE OF IONIZED HELIUM IN THE GALACTIC CENTRE. Churchwell, E.; Mezger, P. G. (Max-Planck Institut fuer Radioastronomie, Bonn). Nature (London); 242: No. 5396, 319-320(30 Mar 1973).

It has been suggested that the present element abundances, and in particular the light elements, H, D, He, and Li, may have been formed during the first few minutes of the birth of the Universe. It is stated, however, that there are serious objections to a primordial origin for He. Most cosmological models predict a He abundance of about 10%, by number, and with a view to determining whether this value holds throughout the Galaxy H and He radio recombination lines were observed in 40 galactic H II regions (the most direct method of determining He abundances in the Galaxy, with the least number of complicating assumptions, is the observation of H and He radio recombination lines in H II regions). A brief summary of the results is given. It was found that the He^+ abundance in all the H II regions was <2%, and the He^{2+} abundance <1%. The possibilities that either the He is essentially all neutral or that there is no He in the galactic centre are discussed. It seems unlikely that a large fraction of He in the H II regions exists in the neutral state, implying that there is an actual underabundance of He in the galactic centre. Cosmological implications of this would be far reaching. (UK)

3682 RELATIVISTIC EFFECTS FOR MOVING TERRESTRIAL CLOCKS. Burt, E. G. C. (Ministry of Defence, London). Nature (London) Phys. Sci.; 242: No. 119, 94-95(9 Apr 1973).

Reference is made to Hafele (Nature 227: 270 (1970)) who deduced that an air borne clock, after circumnavigating the Earth, could be either fast or slow when compared with a clock that remained stationary on the Earth's surface, depending on the direction of travel; also that in neither the east-bound nor the west-bound case would the usually accepted result be obtained-namely, that the "moving" clock would run slow by a factor $(1-v^2/c^2)^{\frac{1}{2}}$. Hafele's apparently anomalous and nonrelativistic conclusions were criticised by Schlegel (Nature Phys. Sci. 229: 237(1971)), who objected to the background system of coordinates employed by Hafele to evaluate the clock rates, leading to erroneous results. It is stated that the problem can be treated more directly in terms of a coordinate system rotating with the Earth. The discussions presented support Hafele's view that the time difference is directionally dependent provided a complete circumnavigation is made, a result that seems to be borne out by experiment. (UK)

3683 IMPLICATIONS FOR GEOPHYSICS OF MODERN COSMOLOGIES IN WHICH G IS VARIABLE. Wesson, P. S. (Cambridge Univ., Eng.). Quart. J. Roy. Astron. Soc.; 14: No. 1, 9-64(Mar 1973).

The subject is dealt with in sections: section I outlines the scope of the connection between cosmology and geophysics, leaving out geomagnetism for the reasons given. Section 2 reviews the palaeogeographic need for expansion and its relation to continental drift and convection in the mantle. Section 3 examines theories in which G depends on time: in subsections 3.1 (Milne), 3.2 (Dirac), 3.3 (Jordan), 3.4 (Kapp), 3.5 (Brans–Dicke), 3.6 (Prokhovnik), and 3.7 (Hoyle–Narlikar). The conclusion of Section 2 is that the expanding Earth hypothesis is viable, while Section 3 suggests that the most likely cosmological theories, considered on the grounds of intrinsic acceptability and agreement with geophysical data, are those of Hoyle–Narlikar or Jordan–Brans–Dicke, followed by Milne, Prokhovnik, and Dirac (considered without the support of the Jordan theory), and lastly, Kapp's hypothesis, which is almost certainly wrong. Section 4 considers the rate of expansion indicated by all available evidence, the most probable value being a constant rate of increase in radius of 0.66 mm yr^{-1} over the last 3×10^9 yr at least, corresponding to expansion of the globe from an initially sial-covered state. Section 5 examines data connected with the rotation and orbital motion of the Earth, the conclusion being that the small disparity present between tidal slowing and the total deceleration can be explained on the basis of a cosmology in which G decreases with time as per Hoyle–Narlikar (Section 3.7). Section 6 is a discussion of the whole field of enquiry as it affects cosmology and geophysics; Section 7 restates the basics results that can be considered established to some degree of certainty: the Earth's radius is probably increasing at about 0.6 to 0.7 mm yr^{-1}, the rate being constant and the cause almost certainly cosmological. What is really needed is a precision method of measuring the rate of change of G. (auth)

Planetary Phenomena

Refer also to abstract 3646.

3684 INTERPRETATION OF HYDROGEN QUADRUPOLE AND METHANE OBSERVATIONS OF JUPITER AND THE RADIATIVE PROPERTIES OF THE VISIBLE CLOUDS. Hunt, G. E. (Jet Propulsion Lab., Pasadena, CA). Mon. Notic. Roy. Astron. Soc.; 161: No. 3, 347-363(1973).

A description is presented of the most detailed and physically realistic analysis yet of the published observations of the hydrogen quadrupole lines and the R-branch of the $3\nu_3 CH_4$ band within the framework of present understanding of the physical processes involved. The results give a self-consistent model for the structure composition of the Jovian atmosphere and the radiative properties of the visible clouds at the centre of the disc. The visible clouds are represented by two distinct layers; a thin layer in the upper troposphere and a dense cloud whose top is at ~2 atm level. This analysis suggests that for these observations the upper cloud is optically thin at visible wavelengths characterized by an isotropic optical thickness of τ 1.5 to 3.0 and an isotropic single scattering albedo of ω 0.996 ± 0.003. The results also indicate mixing ratios for the main constituents of H_2:He = 6:1 and $CH_4/H_2 = (7 \pm 1) \times 10^{-4}$. (auth)

3685 CHEMICAL COMPOSITION OF SOME APOLLO 14 LUNAR SAMPLES. Wiik, H. B. (Finnish Research Council for Sciences, Helsinki); Maxwell, J. A.; Bouvier, J. L. Earth Planet. Sci. Let.; 17: No. 2, 365-368(Jan 1973).

Major, minor, and trace element data, hitherto unpublished, are given for Apollo 14 samples 14163, 14259, 14303, 14305, and 14306, with brief details of the analytical procedures used. As found previously for the Apollo 11 and 12 samples, volatile constituents such as water, fluorine, and carbon dioxide are present in very low concentrations, but the Apollo 14 samples are characterized by much higher contents of sodium, potassium, and phosphorus. The values for TiO_2 continue the downward trend previously noted. (auth)

3686 MISSING PLANET. Napier, W. M.; Dodd, R. J. (Royal Observatory, Edinburgh). Nature (London); 242: No. 5395, 250-251(23 Mar 1973).

The idea that asteroids are fragments of an exploded planet is widely accepted, and it has been argued that a planet vanished between Mars and Jupiter some 16 m.y. ago, and that the asteroids are remnants of this event. Other possibilities, however, have been suggested, including the production of asteroids by successive collisions between a few primaeval planetoids; it has also been suggested that the asteroids are in the process of forming a single planet by accretion. In this discussion mechanisms incapable of providing the energy needed to break up the hypothetical planet and remove most of its mass beyond the solar system are eliminated. The possibility of chemical, gravitational, and nuclear mechanisms is discussed. Chemical mechanisms appear to be excluded, and the same applies to gravitational mechanisms. Nuclear effects might be the heat released by radioactive decay somehow converted to kinetic energy, or fusion, or chain reaction. Radioactive decay is a slow process, and if an explosion is to result the energy generated must be stored; a high pressure core must develop, constrained by a solid mantle until bursting occurred, but any explosion would lack the required energy by a factor of ~10^4. Similar objections apply to H fusion reactions. Assuming a relative ^{235}U abundance throughout the planet equal to the terrestrial crustal abundance there is just enough energy to disperse the planet if the ^{235}U could be assembled into a supercritical mass, but it is improbable that enormous numbers of sub-critical masses of ^{235}U could be assembled and brought together simultaneously within the planet. There remains the possibility that the mass might have been in the form of a ring; for the ring to dissipate the particles must either leave the solar system or be absorbed into the Sun, but no mechanism seems to exist whereby bodies of this size could exist for as long and then suddenly disintegrate on a time scale of $\kappa 10^9$ yr. It is concluded that the destruction of a planet or ring with the required mass in the recent past is physically improbable and that explanations must be looked for elsewhere. (UK)

3687 REVIEW OF THE APOLLO LUNAR EXPLORATION PROGRAMME. Kolaczek, B. (Politechnica, Warsaw). Postepy Astron.; 21: No. 1, 65-73(Mar 1973). (In Polish).

A short review is presented of the Apollo 11–16 missions results: lunar surface and atmosphere, observations of x and γ radiation, solar corona, zodiacal light, and meteorites. (auth)

3688 THERMAL EVOLUTION OF THE MOON. Toksoez, M. N.; Solomon, S. C.; Minear, J. W. (Massachusetts Inst. of Tech., Cambridge). Moon; 4: No. 1-2, 190-213(Apr 1972).

The thermal history and current state of the lunar interior were investigated using constraints imposed by recent geological and physical data. Theoretical temperature models were computed taking into account different initial conditions, heat sources, differentiation, and simulated convection. To account for the early formation of the lunar highlands, the time duration of magmatism, and present-day temperatures estimated from lunar electrical conductivity profiles, it was necessary to restrict initial temperatures and abundances of radioactive elements. Successful models required that the outer half of the Moon initially heated to melting temperature, probably due to rapid accretion. Differentiation of radioactive heat sources toward the lunar surface occurred during the first 1.6 billion years. Temperatures in the outer 500 km are currently low, while the deep interior (radius less than 700 to 100 km) is warmer than 1000°C, and is of primordial material. In some models there is a partially melted core. The calculated surface heat flux is between 25 and 30 erg/cm^2 s. (auth)

3689 COMPOSITION AND ORIGIN OF THE MOON. Anderson, D. L. (California Inst. of Tech., Pasadena). Earth Planet. Sci. Lett.; 18: No. 2, 301-316(Mar 1973).

Many of the properties of the moon, including its "enrichment" in Ca, Al, Ti, U, Th, Ba, Sr, and the REE and "depletion" in Fe, Rb, K, Na, and other volatiles can be explained by early condensation processes in the solar nebula. Thermodynamic calculations show than Ca-, Al-, and Ti-rich compounds condense first in a cooling nebula. The initial high-temperature mineralogy is gehlenite, spinel, perovskite, Ca–Al-rich pyroxenes, and anorthite. Inclusions in type III carbonaceous chondrites such as the Allende meteorite are composed primarily of these minerals and are highly enriched in trace refractories such as REE relative to carbonaceous chondrites. These inclusions can yield basalt and anorthosite in the proportions required to eliminate the europium anomaly, leaving a residual spinel-melilite interior. A high Ca–Al deep interior does not imply an unacceptable mean density or moment of inertia for the Moon. The inferred high U content of the lunar interior, both from the Allende analogy and the high heat flow, indicates a high-temperature interior. The model is consistent with extensive early melting, shallow melting at 3 AE, and with presently high deep internal temperatures. It is predicted that the outer 250 km is rich in plagioclase and FeO. The low iron content of the interior in this model raises the interior temperatures estimated from electrical conductivity by some 800°C. The deep interior may be partially molten at the present time. (auth)

3690 PARTICLE TRACK RECORD OF APOLLO 15 GREEN SOIL AND ROCK. Fleischer, R. L.; Hart, H. R. Jr. (General Electric Research and Development Center, Schenectady, NY). Earth Planet. Sci. Lett.; 18: No. 2, 357-364(Mar 1973).

Track densities, track stability, and uranium contents were measured in lunar samples containing abundant green glass spherules from stations 6a and 7 of the Apollo 15 mission. This glass is rather homogeneous in its track registration properties but nonuniform in its uranium content, specific gravity, and bulk etching rate. The major components of a soil sample, 15401, are found to have had an unusually short surface exposure (5×10^5 yr) and to have been stirred at least once, but not often during its lifetime. A nearby soil clod, 15426, appears to have been brought to the surface in the same event. 15405, the rock upon which 15401 was perched, has recorded deformation features and track densities compatible with its surface residence having begun at the same time. (auth)

3691 MEASUREMENTS OF INFRARED RADIATION FROM MERCURY AND THE MOON. Murdock, T. L. Minneapolis; Univ. of Minnesota (1972). 112p. University Microfilms Order No. 73-10,611.

Thesis (Ph.D.).

Studies of the 2.3 to 18 micron infrared radiation from the planet Mercury and the 2.3 to 8.6 micron infrared radiation from the Moon are presented. Experimental results are compared with predictions based on a smooth spherical black body model and it is found that neither object radiates like the model and, although they are not identical, Mercury and the Moon are quite similar. (TSS) (Diss. Abstr. Int., B)

3692 SYNCHROTRON RADIATION SPECTRA. Gleeson, L. J.; Westfold, K. C. (Monash Univ., Melbourne). Proc. Astron. Soc. Aust.; 2: No. 3, 142-144(Oct 1972).

Corrections that must be made to the formula for emissivity η_f due to a power-law energy distribution of unrelativistic charged particles in a uniform magnetic field in directions well away from the field lines when the upper and low cut-off values in the energy distribution are not negligible, are given. (AT)

3693 DYNAMIC SPECTRA OF JUPITER RADIO BURSTS. Ellis, G. R. A. (Univ. of Tasmania, Hobart, Australia). Proc. Astron. Soc. Aust.; 2: No. 3, 157-158(Oct 1972).

Results are reported for observations made of Jupiter between Feb. and Apr. 1972 over the frequency range 2.5 to 18 MHz. (AT)

3694 FORMATION OF THE OUTER PLANETS. Cameron, A. G. W. (Yeshiva Univ., New York). Space Sci. Rev.; 14: No. 3-4, 383-391(1973).

A discussion is given of a number of physical processes which were probably important during the formation of the outer planets if these formed from a gaseous solar nebula in which magnetic effects were not important. Arguments are given that large-scale gravitational instabilities in the solar nebula did not occur. Qualitative consideration is given to the conditions in which dynamical capture of gas onto a planetary core may take place; this may have played a major role in the formation of Jupiter and Saturn. Because of the great difficulty of fractionating hydrogen from helium in the assembly of the outer planets, it is argued that a new approach should be made to the construction of planetary models. Conditions which may lead to the formation of the regular satellite systems are discussed, and the associated problem of removal of primordial angular momentum from Jupiter, Saturn, and Uranus. (auth)

3695 CHEMISTRY OF THE OUTER SOLAR SYSTEM. Lewis, J. S. (Massachusetts Inst. of Tech., Cambridge). Space Sci. Rev.; 14: No. 3-4, 401-411(1973).

Data on the composition of the satellites of the outer planets and the composition and structure of planetary atmospheres are briefly reviewed in light of simple models for the origin of the solar system and the planets. Some crucial tests of present theories are suggested. (auth)

3696 HELIUM ABUNDANCE ON JUPITER. Hunten, D. M. (Kitt Peak National Observatory, Tucson, AZ); Muench, G. Space Sci. Rev.; 14: No. 3-4, 433-443(1973).

Methods of determining helium on Jupiter (and the Jovian planets) are critically surveyed. Current information is consistent with solar abundance, $He/H_2 = 0.11$ by number. The available lines of evidence are the mean density, spectral-line broadening, and stellar occultations. Methods usable from spacecraft flying by are discussed. Observation of far-infrared emission has great promise, but may have to wait the development of entry probes for the greatest assurance. (auth)

3697 MAGNETOSPHERES OF THE PLANETS. Kennel, C. F. (Univ. of California, Los Angeles). Space Sci. Rev.; 14: No. 3-4, 511-533(1973).

Scaling laws for possible outer planet magnetospheres are derived. These suggest that convection and its associated auroral effects will play a relatively smaller role than at Earth, and that there is a possibility that the outer planets could have significant radiation belts of energetic trapped particles. (auth)

3698 RADIO PHYSICS OF THE OUTER SOLAR SYSTEM. Stone, R. G. (Goddard Space Flight Center, Greenbelt, MD). Space Sci. Rev.; 14: No. 3-4, 534-551(1973).

The remote sensing of low-frequency nonthermal radio emission is the astronomy of field and particle phenomena. Observations conducted from space lead to information about the composition and dynamic processes occurring in planetary magnetospheres as well as within the interplanetary and interstellar medium. The potential of this technique is demonstrated by considering observations obtained from Earth orbit missions. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

3699 (AD-750469) OBSERVATIONS OF BEACON TRANSMISSIONS FROM SATELLITES INTELSAT 2F-1 AND 2F-2. Summary Scientific Report, 1 April–30 June 1972. Liszka, L. (Kungliga Vetenskapsakademien, Kiruna (Sweden). Geofysiska Observatoriet). 4 Aug 1972. Contract F61052-67-C-0026. 40p. (AFCRL-72-532). NTIS.

Beacon transmissions from the semi-geostationary satellite Intelstat 2F-1 and the geostationary satellite Intelsat 2F-2 are used for studies of the high latitude ionosphere. Summer-daytime latitudinal variations of the electron content, geomagnetic storm effects and unusual propagation effects in the subauroral ionosphere are studied. (auth)

3700 (N-72-32414) THEORY OF PARAMETRIC PROCESSES IN PLASMA AND DETERMINATION OF ELECTRON CONCENTRATION ON THE POLAR IONOSPHERE. Savchenko, M. A. (National Aeronautics and Space Administration, Washington, D. C.). Oct 1972. 22p. (NASA-TT-F-14589; Pr-101). NTIS.

Consideration was given to the effect of parametric processes and combined scattering of electromagnetic waves on plasmons in turbulent plasma, excited by a flux of charged particles (efflux of electrons in the polar ionosphere). The frequencies and intensities of satellite waves were found. The possibility of determining electron concentration in the ionosphere is indicated and findings concerning the nature of plasma oscillations were obtained. Kinetic equations were obtained for long wave electron Langmuir oscillations (plasmons). (auth) (STAR)

3701 SATELLITE-BORNE POSITIVE ION MASS SPECTROMETER. Raitt, W. J. (University Coll., London); Blades, J.; Bowling, T. S.; Willmore, A. P. J. Phys., E (London); 6: No. 5, 443-452(May 1973).

The instrumentation and subsequent analysis are described for a method of measuring the composition, temperature, and density of the ionic component of the ionospheric plasma in the vicinity of a near-Earth orbiting satellite. Some examples of the results obtained from an instrument mounted on the satellite ESRO-I are presented. (auth)

3702 LUNAR SEMIMONTHLY TIDES IN H AT THE INDIAN EQUATORIAL REGION. Sen, A. K.; Rao, D. R. K. (Indian Inst. of Geomagnetism, Bombay). Proc. Indian Acad. Sci., Sect. A; 77: No. 2, 92-98(Feb 1973).

Fine structure of the lunar semimonthly tides in H at different UT hours is studied at a station under the influence of equatorial electrojet as well as at a station just outside the influence of the electrojet in the Indian region. It is noticed that the amplitude of the tide varies with solar time at the electrojet station and is complex at the non-electrojet station. Known differential vertical upward drift motion of charged particles in and outside the equatorial electrojet belt appear to be responsible for this phenomenon. The maximum deviation in the instantaneous range in H occurs about one day later at Trivandrum than at Alibag. (auth)

3703 APPLICATION OF CORRELATION TECHNIQUES IN THE SEARCH FOR IRREGULARITIES OF THE F2 REGION. Chaudhary, C. P. (Bengal Engineering Coll., Howrah, India). Indian J. Pure Appl. Phys.; 10: No. 10, 728-732(Oct 1972).

Irregularities of the F2 region prevent an accurate prediction of the critical frequency (f_0F2) by any of the routine methods. The published f_0F2 data have been statistically analyzed with a view to understanding the nature of F2 region irregularities. From the results obtained, the mean deviation appears to be related to geographical and geomagnetic coordinates of the ionospheric stations. Since the mean deviation is not wholly random, it is expected that the deviation of f_0F2 from monthly mean hourly value may serve as a useful index in assessing the F2 region irregularities. (auth)

3704 IONOSPHERIC ANOMALIES IN THE NIGHT MESOSPHERE AFTER GEOMAGNETIC STORMS. Nestorov, G. T. (Geophysical Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 11, 1519-1520(1972).

In earlier studies the author found that the night ionospheric absorption of equivalent frequency f_1 = 480 kHz increases during and after geomagnetic storms. As was established by the method of laying epochs and multi-year data in conditions of low and medium solar activity, the absorption maximum as a rule appears in the zero and second day after the geomagnetic storm (SSC). Along with the study of 480 kHz, comparison was made with the behavior of the absorption of frequency f_1 = 75 kHz. In a great many cases there was no substantial change in the absorption of this frequency, but general statistics for the period of minimal solar activity (1964) showed a partial increase of absorption on zero day and a decrease on the second day after the geomagnetic storm. This peculiar behavior led to a check of the night absorption of the third frequency in the region of very long waves. Data on the night absorption of the equivalent frequency f_1 = 25 kHz for the years of quiet Sun (1964–1965) were used and a histogram of the results is presented. (JCW)

3705 NUMERICAL STUDY OF THE SEASONAL VARIATIONS OF THE IONOSPHERE. Tanaka, T.; Hirao, K. (Tokyo Univ.). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 216-226(Dec 1972).

Diurnal variations of electron density in the ionosphere are calculated by solving simultaneous time-dependent continuity equations for O^+, H^+, O_2^+, NO^+ ions and the heat conduction equations for electrons, ions and neutral particles, taking account of the neutral wind observed at St. Santin. The calculated diurnal variations are then compared with observed values at Kokubunji for summer and winter seasons. It is shown that diurnal variations of neutral wind as well as the atomic oxygen density at the turbopause level seem important for the seasonal dependence of the peak electron density of the F2 layer. By using the observed wind, the seasonal dependence of the F2 layer peak electron density can be attributed to an atomic oxygen density, which is three times larger in winter than in summer. (auth)

3706 TWILIGHT ENHANCEMENT OF [O I] 6300-A AIRGLOW. Misawa, K. (Defence Adademy, Yokosuka, Japan). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 227-236(Dec 1972).

Analyses are made of the observational data of the [O I] 6300-A airglow taken at Tohkatta Night Airglow Observatory from May 1968 to May 1969. The onset angle (χ_0) and the rate of intensity enhancement of the morning twilight glow show a seasonal variation. The mechanism of the morning twilight enhancement of the red line is discussed, and it is shown that the predominant mechanisms of the enhancement are the photodissociation of O_2 and the photoelectron impact excitation of oxygen atoms. (auth)

3707 DEVELOPMENT OF WEAK ELECTROJETS DURING THE GROWTH PHASE OF MAGNETIC SUBSTORMS. Iijima, T. (Tokyo Univ.). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 267-270(Dec 1972).

Analysis of data recorded at Tromso, Kiruna, Sodankylä and Mawson during typical substorms in 1965 confirms that weak auroral electrojets (comprising an eastward mini-electrojet in the afternoon region and a westward mini-electrojet in the midnight region) develop during the growth phase. The dates of the storms are enumerated and iso-intensity contour maps show the progressive changes from which the analyses are made. An analysis is demonstrated of the substorm of Sept. 12–13, 1965 for the growth phase. (JCW)

3708 POLAR-CAP PHASE ANOMALIES OF VLF WAVES IN AUGUST 1972. Hakura, Y. (Radio Research Labs., Tokyo); Ishii, T.; Asakura, T.; Terajima, Y. Rep. Ionosphere Space Res. Jap.; 26: No. 4, 280-284(Dec 1972).

A time-history of proton-flare-associated polar-cap disturbances and their modifications due to geomagnetic disturbances that occurred during the first part of August 1972 were analyzed by the phase measurement data of NAA-17.8 kHz, GBR-16.0 kHz, and NPG-18.6 kHz waves. The propagation circuits of these vlf waves pass through the polar cap, the auroral zone, and the subauroral zone, in the northern hemisphere. Preliminary results show that the August 1972 event is considered to be the severest disturbance in the present sunspot cycle and of a scale comparable with the famous February 11, 1958 event. (JCW)

3709 VLF EMISSIONS OBSERVED BY ISIS-2 DURING THE GEOMAGNETIC STORM OF AUGUST 9, 1972. Ondoh, T.; Nagayama, M.; Nishizaki, R. (Radio Research Labs., Tokyo). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 285-286(Dec 1972).

The ISIS-2 passed approximately along a geographic meridian of 142°E from the south to the north over the Kashima station for 07h30m to 07h50m UT, August 9. Two whistler-triggered emissions were observed in this time. The whistler-triggered emission is often observed in the plasmasphere. The observations of a narrow-band hiss inside the plasmapause indicates that the

plasmapause lay in the vicinity of the geomagnetic field line passing through L = 2.72 on the evening side during the main phase (K = 5 to 6) of the geomagnetic storm of August 9, 1972. (JCW)

3710 SOME OBSERVATIONAL RESULTS FOR THE SOLAR–TERRESTRIAL EVENTS IN AUGUST 1972. Rep. Ionosphere Space Res. Jap.; 26: No. 4, 287-322(Dec 1972).

A great solar–terrestrial event occurred in August 1972. Results of the phenomena observed in Japan are discussed. Solar observations at Mitaka; a large flare of August 2, 1972; monochromatic observation of a flare on August 4, 1972; radio features of four major solar events; cosmic-ray intensity variance during August 1–10, 1972; observational record of cosmic-ray variations at various stations; magnetograms at Kakioka on August 4–10, 1972 with K indices and storm tables for three stations in Japan; three-hour-range indices, K, and character figures, C (UT), during August 4–10, 1972; ionospheric variations during August 1–10, 1972; sudden phase anomalies observed at Uji; Doppler observation associated with magnetic storm of August 4 to 6, 1972; and the variations of the night airglow intensities during August 6–13, 1972 are the subjects discussed. (JCW)

3711 USE OF VLF RADIO WAVES IN IONOSPHERIC RESEARCH. Bjoentegaard, G.; Egeland, A. (Det Norske Institutt for Kosmisk Fysikk, Oslo). Phys. Norv.; 6: No. 2, 113-126 (1972).

The main VLF radio techniques used in ionospheric research are briefly reviewed. The types of observations naturally fall into two groups, namely: a) Measurements of Earth-based vlf transmitters which give information about the lower ionosphere. b) Recordings of waves propagating in the whistler mode through the ionosphere and magnetosphere from which information about electron and ion density, temperature, and magnetic field can be obtained. The emphasis is put on presenting results rather than describing theoretical models. (auth)

3712 AURORAL HEATING AND THE COMPOSITION OF THE NEUTRAL ATMOSPHERE. Hays, P. B.; Jones, R. A.; Rees, M. H. (Univ. of Colorado, Boulder). Planet. Space. Sci.; 21: No. 4, 559-573(Apr 1973).

Heating of the neutral atmosphere by auroral particle fluxes and by orthogonal electric fields is responsible for large changes in the thermospheric composition that have been observed by satellite mass spectrometers. Vertical winds of a few meters per second are produced in the region subject to auroral heating; this vertical upwelling drives circulation cells that extend the effects of heating in the auroral region on a global scale. This analysis focuses on the initial phase of a magnetic storm within the auroral region. (auth)

3713 TIME-DEPENDENT STUDIES OF THE AURORA. I. Ion Density and Composition. Jones, R. A.; Rees, M. H. (Univ. of Colorado, Boulder). Planet. Space Sci.; 21: No. 4, 537-557 (Apr 1973).

Ion densities and composition are investigated in a time varying model aurora. There is a time lag between turning on the source of ionization and the resulting increase in ion densities that depends on the species and the height level in the ionosphere, so that altitude profiles of auroral electron densities evolve with time. Characteristic buildup times for the ionization are a few seconds at the altitude of maximum energy deposition, increasing to tens of seconds above and below this level. A wide range of composition ratios, $n(NO^+)/n(O_2^+)$ and $n(NO^+)/n(O^+)$, can be expected, depending on the time an observation is made during buildup or decay of ionization. The concentrations of atomic nitrogen and nitric oxide increase as a result of auroral ionization, but the associated characteristic times are long compared to the average duration of an 'auroral event.' Thus, intermittent auroral bombardment could result in a gradual buildup of these minor constituents in the auroral atmosphere. Variations in the electron density during pulsating, fluctuating, or coruscating aurora lag the source function variations by a few seconds in a typical aurora. (auth)

3714 GEOMETRY OF RADIO AURORA. Pyatsi, A. K.; Sverdlov, Y. L. Ann. Geophys.; 28: No. 3, 633-637(Jul 1972).

The distributions of the observed radar cross sections for auroral scattering are plotted for different aspect angles (off-perpendicular angles). The results do not demonstrate a continuously decreasing backscattering strength with increasing aspect angle. These results together with spaced radar observations lead to the conclusion that the backscattering intensity peaks occur at a nonzero value of the aspect angle Ψ_0 and that the aspect sensitivity around Ψ_0 is always very sharp. The probability of detecting auroral echos is usually greater for small aspect angles, the physical conditions in the disturbed polar ionosphere generally favoring small values of Ψ_0. (FR)

3715 AURORAL PARTICLES AND FIELDS. Evans, D. S. (York Univ., Toronto). Ann. Geophys.; 28: No. 3, 639-659(Jul 1972).

Progress in the knowledge of auroral particles and fields since 1967 is reviewed. The discussion of auroral fields is confined to observational data on auroral-latitude electric fields obtained by Ba release and electrostatic probe techniques. The review of auroral charged-particle precipitation covers rocket and satellite measurements. The rocket observations encompass detailed measurements of the energy spectral, intensity, spatial, pitch-angle distribution, and temporal character of the charged-particle beam precipitating above visual aurora. Particular emphasis is placed on the features of the ion influx and on the observations of field-aligned electron precipitation. The gross properties of the high-latitude, low-energy particle precipitation as determined from low altitude satellite studies is discussed with stress on the local time-latitude behavior of the particle influxes. The finer scale structure in the particle influx, as detected by the sophisticated Injun-5 experiments and observed to be associated with visual aurora, is also touched upon. Finally, the character of the charged-particle population as observed in the geomagnetic equator on lines of force that presumably thread the auroral regions is discussed. A clear lack of agreement between features of the low-latitude population and character of the auroral-particle beam observed above the atmosphere is emphasized. The presence of a particle acceleration operating along a line of force may be suggested to account for these discrepancies. (FR)

3716 UPPER ATMOSPHERIC TEMPERATURES FROM DOPPLER LINE WIDTHS. 5. Auroral Electron Energy Spectra and Fluxes Deduced from the 5577 and 6300 A Atomic Oxygen Emissions. Zwick, H. H.; Shepherd, G. G. (York Univ., Toronto). Planet. Space Sci.; 21: No. 4, 605-621(Apr 1973).

Further data were obtained from the auroral O I 5577-Å emission with a Wide Angle Michelson Interferometer (WAMI), and the first observations were made with it on the 6300-Å emission. The method used for converting emission intensities and temperatures to auroral electron fluxes and energy spectra is described. Data for the 5577-Å emission are presented for the (lack of) heating in auroral forms, vertical temperature profiles in aurora, electron flux, and energy spectrum variations in pulsating aurora, and a "cold" subvisual auroral arc. Data from the O I 6300-Å emission are presented for the diurnal variation of exospheric temperature and for the thermalization of $O(^1D)$ in the F region. (auth)

3717 CYLINDRICAL SHELL MODEL OF THE NASA-MPE BARIUM ION CLOUD EXPERIMENT. Grauer, A. D.; Prak, J. W. L.; Jenkins, A. W. (North Carolina State Univ., Raleigh). Planet. Space Sci.; 21: No. 4, 643-651(Apr 1973).

A computer model is developed using infinitely long concentric cylindrical shells to represent the neutral atoms, ions, and electrons in the barium cloud. The neutral shells are given a distribution of positions and velocities whose parameters are chosen to be consistent with the dynamics of the release. From this distribution, the ion and electron shells are generated at random using the observed time constant for photoionization. The ion and electron shells thus formed are followed using self-consistent equations of motion. Various averages that could be compared with observation of the actual cloud are calculated at regular time intervals. An unexpected result is the predicted very early return of the magnetic field within the cloud to its ambient value. (auth)

3718 MEASUREMENTS OF WAVE NORMAL DIRECTIONS OF WHISTLER MODE SIGNALS IN THE IONOSPHERE BY MEANS OF THE ROCKET DOPPLER TECHNIQUE. Kimura, I.; Tomimoto, T.; Hiraishi, K. (Kyoto Univ.). Planet. Space Sci.; 21: No. 4, 671-682(Apr 1973).

Wave normal directions of vlf signals propagating through the ionosphere can be determined by measuring Doppler frequency shift of the signals by means of rocket-borne receivers. Two rockets were launched to detect the NWC signal of 22.3 kHz that was transmitted from Australia and propagated on two completely different paths, one being propagated through the Earth-ionosphere waveguide and up to the rocket, the other propagated down to the rocket by the whistler mode directly from the source in the opposite hemisphere. The wave normal directions of the latter mode were almost vertically downward in the ionosphere in the northern hemisphere, although substantial error was involved in the determination of the wave normal direction for a part of the upgoing flight of the rockets, due to the relative geometry of the directions of the rocket flight and the geomagnetic field. The effect of the horizontal gradients of the ionosphere on the above results were found to be not significant. From the experimental results it is concluded that field-aligned ducts stretching down to the

rocket altitudes did not exist, at least, during the rocket flights. (auth)

3719 OBSERVATION OF STABLE AURORAL RED ARCS FROM SOUTHERN AFRICA. Carman, E. H.; Heeran, M. P.; Stevenson, R. W. H. (Univ. of Botswana, Lesotho and Swaziland, Roma, Lesotho). Planet. Space Sci.; 21: No. 4, 683-686(Apr 1973).

The equatorial edge of a SARAC (stable auroral red arc) was observed during the recovery phase of a 200-γ magnetic storm between 0000 and 0140 UT on December 18, 1971 at Roma (latitude 29.7°S and longitude 27.7°E) in Lesotho, Southern Africa. An arc of similar structure also appeared south of Roma on the night of 4 August 1972. Although SARARCS have been reported by numerous observers at times of geomagnetic storms in the northern hemisphere and Australia, the present observations are the first reported from Southern Africa. A description of the 1971 observations is given. Unusual features of the arc are its marked skewing in relation to the invariant latitude, its high apparent velocity normal to the skewed direction compared with the maximum velocity of 87 m sec^{-1} so far reported for northern hemisphere arcs, and the appearance of part of the arc at an L value of 1.50 that is well to the equatorward side of the zone in which arcs have previously been observed. (UK)

3720 DISCUSSION ON GEOMAGNETIC DISTURBANCES IN THE POLAR CAP: S_q AND DP-2 BY K. KAWASAKI AND S.-I. AKASOFU. Nishida, A. (Tokyo Univ.). Planet. Space Sci.; 21: No. 4, 691-692(Apr 1973).

In an examination of the geomagnetic and auroral data in the polar cap, Kawasaki and Akasofu (Planet. Space Sci., 20: 1163(1972)) concluded that it is not necessary to invoke DP 2 as a new mode of the disturbance field that is distinct from the polar substorm. In this note, however, it is pointed out that the argument of Kawasaki and Akasofu for the nonexistence of DP 2 is based on the premise that requires the nonexistence of DP 2 for its validity. Their conclusion that DP 2 does not exist is built in their argument from the start, and thus their paper cannot be taken as valid proof for the nonexistence of DP 2. (UK)

3721 BEHAVIOR OF MIDDAY AURORAS DURING SUBSTORMS. Akasofu, S. I.; Kimball, D. S. (Univ. of Alaska, College). Planet. Space Sci.; 21: No. 4, 696-698(Apr 1973).

The behavior of midday auroras during auroral substorms is examined on the basis of all-sky photographs taken from the South Pole station. It is indicated that the model of auroral substorms constructed by Starkov and Feldstein (Geomag. Aeron. 7: 294(1967)) needs some modifications. (auth)

3722 DISCUSSION OF THE ENERGY TRANSFER FROM $N_2(A^3\Sigma_{u^+})$ TO $O(^1S)$ IN PULSATING AURORA. Brekke, A. (Auroral Observatory, Tromsoe, Norway). Planet. Space Sci.; 21: No. 4, 698-702(Apr 1973).

In a recent paper, Brekke and Pettersen (Planet. Space Sci., 20: 1569 (1972)) introduced a method for estimating any indirect process in the production of the $O(^1S)$ atoms in pulsating aurora; for 38% of their data they found that the decay time for the indirect mechanism was shorter than the effective lifetime of the ^1S state. These data are related to the energy transfer from the $N_2(A^3\Sigma)$ molecules to the $O(^1S)$ state, and evidence is found for this process to contribute in the altitude range below 125 km. (auth)

Magnetospheric Phenomena

Refer also to abstract 2721.

3723 (N-72-32781) CALCULATIONS OF SYNCHROTRON EMISSION FROM THE TERRESTRIAL RADIATION BELTS. Johnson, R. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1972. 36p. (NASA-TM-X-66015; X-693-72-254). NTIS.

A theoretical model was developed to allow for the calculation of the synchrotron emission arising from high-energy electrons trapped in the Van Allen belts of a planet with a dipole magnetic field. The model is general enough to allow for the calculation of the intensity of radiation received by an observer at any distance from and any latitude about the planet. The model is used to compute the emission from the Earth's Van Allen belts that one should expect at various latitudes at a distance of 1.92 earth radii, the position of the Radio Astronomy Explorer satellite that was launched in 1968, for the frequencies 1.3 MHz and 2.2 MHz. (auth) (STAR)

3724 (N-72-32783) LATITUDE AND LOCAL TIME DEPENDENCE OF PRECIPITATED LOW-ENERGY ELECTRONS AT HIGH LATITUDES. Gustafsson, G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Aug 1972. 45p. (NASA-TM-X-66035; X-645-72-293). NTIS.

Data from particle detectors on board the satellite OGO-4 were used to study the precipitation of electrons in the energy range 0.7 to 24 keV. The latitude dependence of these particles in the local time region from midnight to dawn was investigated in detail. The analysis shows that the precipitation of particles of energies 2.3 to 24 keV is centered at an invariant latitude of about 68° at midnight with a clear shift in latitude with increasing local time and this shift is more pronounced for lower energies. The highest fluxes of particles in this energy interval are measured at midnight and they decrease rapidly with local time. The data in the energy range 2.3 to 24 keV support a theory where particles are injected in the midnight region from the tail gaining energy due to a betatron process and then drift eastwards in a combined electric and magnetic field. The main part of the electrons at 0.7 keV shows a different behavior. They seem to undergo an acceleration process which is rather local, sometimes giving field aligned fluxes which may be superimposed on the background precipitation. (auth) (STAR)

3725 (N-73-10378) HIGH-FREQUENCY HALL CURRENT INSTABILITY. Lee, K.; Kennel, C. F.; Kindel, J. M. (California Univ., Los Angeles. Plasma Physics Group). Aug 1970. 14p. (NASA-CR-130078; R-75). NTIS.

The Hall current electrojet instability was studied to determine if it generates vlf hiss in the auroral zone of magnetic substorms. Using the kinetic equations with particle conserving Krook collision operator for electrons and ions, and Poisson's equation, it is shown that in the low-frequency region, the range of frequency of unstable modes increases as the electron density increases, and that the high-frequency component must be taken into account in calculations of turbulent saturation of the Hall current instability driven beyond threshold. It is concluded that Hall currents can generate waves in the vlf hiss frequency band which are related to local auroral electrojet activity. (STAR)

3726 (N-73-10392) SYNOPTIC STUDY OF THE NATURE AND EFFECTS OF FIELD ALIGNED LOW-ENERGY ELECTRON PRECIPITATION IN THE AURORAL REGIONS. Berko, F. W. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Oct 1972. 108p. (NASA-TM-X-66065; X-646-72-384). NTIS.

Thesis.

A synoptic study is presented of field-aligned precipitation events observed during a 16-month period, representing a full 4π precession of the satellite orbital plane in magnetic local time. The morphology of this type of precipitation, its nature, and relationships between this phenomenon and other geophysical events are discussed in the context of the 16-month data base. (auth) (STAR)

3727 (N-73-11816) UK-5 VAN ALLEN BELT RADIATION EXPOSURE: A SPECIAL STUDY TO DETERMINE THE TRAPPED PARTICLE INTENSITIES ON THE UK-5 SATELLITE WITH SPATIAL MAPPING OF THE AMBIENT FLUX ENVIRONMENT. Stassinopoulos, E. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Oct 1972. 226p. (NASA-TM-X-66098; X-601-72-388). NTIS.

Vehicle encountered electron and proton fluxes were calculated for a set of nominal UK-5 trajectories with new computational methods and new electron environment models. Temporal variations in the electron data were considered and partially accounted for. Field strength calculations were performed with an extrapolated model on the basis of linear secular variation predictions. Tabular maps for selected electron and proton energies were constructed as functions of latitude and longitude for specified altitudes. Orbital flux integration results are presented in graphical and tabular form; they are analyzed, explained, and discussed. (auth) (STAR)

3728 (N-73-11817) GREENSTADT's BINARY INDEX CRITERION. Northrop, T. G.; Birmingham, T. J. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Nov 1972. 12p. (NASA-TM-X-66105; X-640-72-425). NTIS.

The Greenstadt-type criterion for distinguishing between laminar and pulsating (i.e., irregular) bow shock crossings can be expressed as a critical angle between the shock normal and the magnetic field. When the field is more tangent to the shock plane than this critical angle, the shock is laminar. More importantly, the requirement of Galilean invariance of the physics underlying

such a criterion reveals that the Greenstadt p index must vary inversely as the solar-wind velocity. (auth) (STAR)

3729 INTERACTION OF SOLAR WIND WITH INTERSTELLAR NEUTRAL GAS AT THE HELIOSPHERIC BOUNDARY. Obayashi, T. (Tokyo Univ.). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 207-215(Dec 1972).

The interaction of the solar wind with interstellar hydrogens penetrating into the heliosphere is reviewed. The solar wind is found to be decelerated by the neutral gas, and it degrades into subsonic regime at the heliocentric distance of 100 to 150 AU. A brief description of the interstellar wind and discussions on the plasma parameters in the outer heliosphere are also given. (auth)

3730 RECURRENT MAGNETIC STORMS IN RELATION TO THE STRUCTURE OF SOLAR AND INTERPLANETARY MAGNETIC FIELDS. Saito, T. (Tohoku Univ., Sendia). Rep. Ionosphere Space Res. Jap.; 26: No. 4, 245-266(Dec 1972).

Through an auto-correlation analysis of the geomagnetic activity index since 1932, the recurrent-type geomagnetic storms are interpreted in terms of the butterfly model on the active region on the solar source surface (ARS) from which intense solar magnetic field is pulled out to the interplanetary space, where ARS shows a gradual shift in location from high heliographic latitudes to low during one solar cycle. An attempt is made to explain the observed 180° phase-shifted two series of annual waves in the recurrent storms by the SEQSM and the ARS effects. In the SEQSM effect, the annual variation of the interplanetary magnetic-field strength caused by the geometric relation between the solar-equatorial (SEQ) and the solar-magnetospheric (SM) systems is considered important, while in the ARS effect, the recurrence of the intense interplanetary magnetic field conveyed from the ARS is essential. A combination of these two effects is concluded to be fundamental for the apparent semiannual variation of recurrent magnetic storms. (38 references) (auth)

3731 DETERMINATION OF THE ENERGY OF THE PARTICLES RESPONSIBLE FOR Pcl PULSES. Glangeaud, F.; Lacoume, J. L. (Univ., Grenoble, France). Compt. Rend., Ser. B; 276: No. 4, 161-164(22 Jan 1973). (In French).

The intercorrelation function of Pcl signals from two observatories yields the difference between their respective arrival times. It is thus possible to determine the energy of the particles responsible for these pulsations. The optimum recording conditions were deduced from a statistical analysis of the simultaneously obtained results. A drift of these particles towards the west was observed. (FR)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

3732 (BNL-tr-533) EQUILIBRIUM OF NEGATIVE IONS IN HIGH-INTENSITY PLASMA SOURCE. Gabovich, M. D.; Naida, A. P.; Isaev, F. M. Translated by S. J. Amoretty from Ukr. Fiz. Zh. (Russ. Ed.); 15: No. 4, 667-671(1970). 11p. Dep. NTIS $3.00.

The plasma of a reflex discharge used as a source of negative ions and the processes of production, disintegration, and the drain of negative ions, which directly determines the strength of this source, are studied experimentally. On this basis a dependence of the negative ion current on the discharge current is obtained. (JFP)

3733 (SGAE-PH-139/73) AN ANALYTICAL METHOD FOR THE CALCULATION OF STATIONARY SELF-CONSISTENT SPACE CHARGE FIELDS. Krempl, P. W. (Oesterreichische Studiengesellschaft fuer Atomenergie G. M. B. H., Seibersdorf. Physik-Institut). Feb 1973. 12p. (CONF-720948-15; SGAE-2086). Dep. NTIS (U. S. Sales Only) $3.00.

From second international conference on ion sources; Vienna, Austria (11 Sep 1972).

Theoretical treatments on space-charge neutralization of continuous ion beams are closely related to the problem of the calculation of space-charge potentials in a self-consistent way. To solve this problem for stationary ion beams with zero-emittance and uniform total energy, neglecting the direct Coulomb-interactions between the particles, a transformation in a space with the parameters of trajectory-manifold and the transit time as generalized coordinates is advantageous. This method delivers a differential equation for the components of the metric tensor, which involves the Poisson-equation, the equation of motion, and the continuity-equation in a self-consistent form. Setting the value for the density distribution along an initial surface and taking into account the geometrical requirements on the searched solution, this equation will be reduced to an equation between the velocity and the generalized momenta. This differential equation has been tested successfully on the three classical Langmuir-cases of space-charge-flow and allows furthermore some general statements about stationary self-consistent ion beams. A generalization of this equation for beams with finite emittance is possible, but the resulting equation seems to be very hard to solve. Nevertheless, one obtains a useful expression for the density-distribution in the beam. (auth)

3734 QUANTUM-MECHANICAL MODEL FOR THE IONIZATION AND EXCITATION OF ATOMS DURING SPUTTERING. Schroeer, J. M. (Illinois State Univ., Normal); Rhodin, T. N.; Bradley, R. C. Surface Sci.; 34: No. 3, 571-580(Feb 1973).

A quantum-mechanical model is developed for the process by which an atom is excited or ionized as it is sputtered from a metal surface. The probability of excitation is given by $R = (A/\Delta E)^2(\hbar v/a\Delta E)^n$, where A is the binding energy of a surface atom before sputtering, v is its average velocity after sputtering, a is the thickness of the surface, and ΔE the excitation energy. For ionization, $\Delta E = I - \phi$, with I the ionization energy of the sputtered atom, and ϕ the work function of the surface. Available experimental data for ionization are fitted best with $a = (1.4 \pm 0.3)$ Å, and $n = 2.5 \pm 0.3$. The model is expected to be applicable to bombarding energies up to about 100 keV. (26 references) (auth)

3735 OBSERVATION OF KIKUCHI PATTERN DURING SPUTTERING. Browning, R.; Townsend, P. D. (Univ. of Sussex, Brighton, Eng.). Phil. Mag.; 27: No. 4, 999-1000(Apr 1973).

Kikuchi patterns were observed as an etched, or re-sputtered, pattern in the sputtered deposit obtained by electron irradiation of sodium chloride. (auth)

3736 VELOCITY DISTRIBUTION IN AN ATOMIC BEAM. Abashev, Yu. G.; Voronin, G. F.; Valitov, R. A. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 11, 1679-1681(Nov 1972).

Translated from Izmer. Tekh.; 15: No. 11, 53-55(Nov 1972).

The velocity distribution for a beam of thallium atoms was examined. (JFP)

Atomic and Molecular Properties

3737 NEW GAUSSIAN WAVE FUNCTIONS FOR THE HYDROGEN ATOM. Tsapline, B. (Univ., Karlsruhe, Ger.). Compt. Rend., Ser. C; 276: No. 3, 253-256(15 Jan 1973). (In French).

The energy of the ground state of the hydrogen molecule was calculated using equilibrized atomic orbitals having identical weights at short and long distances from the nucleus. (France)

3738 DERIVATION OF GENERAL OPEN-SHELL SCF EQUATIONS FOR ATOMS AND MOLECULES WITH A GREEN FUNCTION METHOD. Albat, R.; Gruen, N. (Univ., Geissen, Ger.). J. Phys., B (London); 6: No. 4, 601-603(Apr 1973).

A new general method is described for obtaining SCF orbitals for electronic systems without restrictions on the symmetry of the open shells. With a Green's function method an optimal SCF operator is constructed for each state of a given configuration. The unperturbed one-particle Green's function is optimal with this operator and permits a quasiparticle interpretation. The SCF equations are derived in matrix formulation convenient for numerical applications within a limited basis set. It is shown that the SCF orbitals thus obtained satisfy the necessary conditions for the energy to be stationary. An application of the SCF method is given for the three lowest S states of the helium atoms. (auth)

3739 UNIFIED CALCULATION OF THE STARK BROADENED PROFILE OF LYMAN-ALPHA. Bottcher, C. (Univ. of Manchester, Eng.). J. Phys., B (London); 6: No. 4, L54-L58(Apr 1973).

The generalized phase shift theory previously discussed (Bottcher, C.; J. Phys. B. Atom. Molec. Phys.; 4: L99-102(1971)) was applied to the Stark broadening of the 2P-1S line in hydrogen. Complete allowance is made for both electron and proton dynamics. The results differ somewhat from those obtained by Smith et al (Phys. Rev.; 185: 141-51(1969)) using another unified theory. The scanty experimental data do not make it possible to choose between the theories. (auth)

3740 APPROXIMATION TO THE METHOD OF LOCAL ORBITALS. Kunz, A. B. (Univ. of Illinois, Urbana). J. Phys., B (London); 6: No. 4, L47-L50(Apr 1973).

The first-order in overlap approximation to the Adams-Gilbert equation derived previously by Kunz (Phys. Stat. Solidi.; 36: 301-9(1969)) is examined. It is shown that this approximation is far more general than previously assumed and is an exact member of the family of local orbitals equation derived by Gilbert (1964). The relation of this result to the method proposed by Anderson (Phys. Rev. Lett.; 21: 13-16(1968) and Phys. Rev.; 181: 25-32 (1969)) is discussed, and a class of situation is found where the present formalism may be preferable. Approximations to the present case are discussed and illustrated with a simple calculation for the He_2 molecule. (auth)

3741 ISOTOPE SHIFT OF ^{20}Ne, ^{21}Ne, AND HYPERFINE STRUCTURE OF ^{21}Ne IN THE LINES 6096 A AND 6074 A OF NEON I. Champeau, R. J.; Keller, J. C. (CNRS, Orsay, France). J. Phys., B (London); 6: No. 4, L76-L79(Apr 1973).

The odd-even isotope shift in the $\lambda = 6096$ Å and $\lambda = 6074$ Å lines of Ne I has been remeasured by conventional high resolution optical spectroscopy; in contradiction with a value published by Ducas et al (Phys. Rev.; 5: 1036-43(1972)), the shift has been found in good agreement with the mass-shift formula. In addition, the hyperfine structure coupling constants of the $1s_4$ and $2p_4$ levels of Ne I have been obtained. (auth)

3742 ANALYTICAL RADIAL ORBITALS. Kantseryavichyus, A. Yu. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 5, 731-743(1972). (In Russian).

A method for obtaining analytical radial orbitals approximating the solutions of Hartree–Fock equations to a good extent was proposed. Such orbitals for the configurations $1s^22p^N$ and $1s^22s2p^N$ ($Z = 9$) are listed. Another, less accurate, type of radial orbitals is discussed as well. The parameters of such orbitals for the Sr atom and outer shells of Cd, Xe,and Yb atoms are tabulated. The differences between values for F^k and $\langle r^k \rangle$ and those calculated with the help of the solutions of Hartree–Fock equations do not exceed 6 percent. (auth)

3743 APPLICATION OF THE EXTENDED METHOD OF CALCULATION TO RARE EARTHS ATOMS AND IONS WITH THE ELECTRONIC CONFIGURATION $4f^N$. Vizbaraite, Ya. I.; Stasyukaitis, V. Yu.; Strotskite, T. D. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 5, 745-751(1972). (In Russian).

The extended method of calculation was applied to the research into the electronic configuration of the rare earths atoms and

ions. The parameters of the analytical 4f radial orbitals were found by using the nonrelativistic energy of the centrum of the configuration. The values of these parameters together with the radial integrals are tabulated. The screening method for the closed shells was used. The distances between the energy levels for the cases where experimental data are available are given and compared with the results obtained in the ordinary method of calculation by using the solution of the conventional Hartree–Fock equations. (auth)

3744 INFLUENCE OF COULOMBIC FRAGMENTATION ON THE MICROSPECTRUM OF γ RAYS EMITTED BY A GASEOUS SOURCE. Dautov, L. M.; Kadykenov, M. M.; Kaipov, D. K.; Adymov, Zh. I.; Bimurzaev, S.; Shinkeev, A.; Khlystov, A. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 14-17(1972). (In Russian).

Gamma radiation from nuclei with prior K-capture or β-decay or internal conversion were investigated. The charges forming after the initial decay convert the molecules to positive ions which fly apart under the action of Coulomb forces. A law of ionic motion was found, according to which it was possible to calculate the microspectrum of the resulting γ radiation. If the lifetime of the excited level is known, then the cross section of resonance scattering of γ quanta can be derived. The results obtained enable one to establish the time separating the I and II steps of the cascade of radiationless Auger transitions in an atom of bromine = $(1 \pm 1) \times 10^{-14}$ sec. (tr-auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 3936, 4230, and 4239.

3745 (JINR–P2-6996) INFRARED SINGULARITIES AND HYPERFINE SPLITTING IN POSITRONIUM. Nyun'ko, N. E.; Tyukhtyaev, Yu. N.; Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The contribution of the soft (infrared) photons to the hyperfine shift of the positronium energy levels is studied in the framework of the quasipotential approach in quantum field theory. It is shown that the partial departure off the mass shell with the help of the total energy parameter allows the infrared divergences to be completely eliminated and, thereby, to confirm more rigorously the results of the previous calculations. (auth)

3746 MUONIUM ENERGY LEVELS FOR n = 2. Owen, D. A. (CNRS, Marseille). Phys. Lett.; 44B: No. 2, 199-201(16 Apr 1973).

The initial results of a calculation of the muonium energy levels for n = 2 is reported. The results, which contain all recoil corrections through order α^5 are combined with previously calculated higher order binding corrections to yield 1047.03 MHz for the muonium Lamb shift and 10,921.50 for the $2P_{\frac{3}{2}} - 2P_{\frac{1}{2}}$ fine structure interval. A lower order, quadratic recoil term, which is insignificant for the hydrogen Lamb shift, contributes −0.17 MHz to the muonium Lamb shift. (auth)

3747 POSITRON ANNIHILATION IN PHOTOGRAPHIC EMULSION GRAINS. Gainotti, A. (Univ., Parma, Italy). Phys. Lett.; 43A: No. 5, 404-406(9 Apr 1973).

Positron decay curves in sensitized emulsion grains and in AgBr crystals have been measured. The results seem to show that annihilation process is not affected by sensitizing specks. (auth)

Collision Phenomena

Refer also to abstracts 2654 and 4286.

3748 (CEA-CONF–2195) PRESENT STATUS OF MULTIPHOTON EXCITATION AND IONIZATION OF ATOMS. Mainfray, G.; Manus, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 5 Apr 1972. 23p. (CONF-720558–2). Dep. NTIS (U. S. Sales Only) $3.25.

From seventh international conference on quantum electronics; Montreal, Canada (8 May 1972).

The review of multiphoton excitation and ionization of atoms covers perturbation theory, resonant excited state mechanism, experimental arrangement, results for rare gases and alkaline atoms, direct observation, atomic hydrogen ionization, probabilities, and optical field emission. (JFP)

3749 (CEA-CONF–2249) MULTIPHOTON IONIZATION OF RARE GASES AND ATOMIC HYDROGEN. Mainfray, G. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 3 Aug 1972. 25p. (CONF-720976–3). Dep. NTIS (U. S. Sales Only) $3.25.

From conference on interaction of electrons with strong electromagnetic field; Balatonfuered, Hungary (11 Sep 1972).

The present status of multiphoton ionization of rare gases and atomic hydrogen is presented. (JFP)

3750 (COO–2092-22) INTERMOLECULAR POTENTIALS OF SYMMETRIC RARE GAS PAIRS FROM ELASTIC DIFFERENTIAL CROSS SECTION MEASUREMENTS. Farrar, J. M.; Schafer, T. P.; Lee, Y. T. (Chicago Univ., Ill.). 1972. 24p. (CONF-730104–1). Dep. NTIS $3.25.

From international centennial Boltzmann seminar; Providence, Rhode Island, USA (22 Jan 1973).

Two supersonic beams of rare gas atoms at various temperatures were crossed to obtain differential cross sections from which intermolecular potentials of symmetric rare gas pairs could be derived. Helium, neon, argon, krypton, and xenon are discussed. (JFP)

3751 (N–73-11730) EXCITATION OF ATOMIC NITROGEN BY ELECTRON IMPACT. Stone, E. J.; Zipf, E. C. (Pittsburgh Univ., Pa. Dept. of Physics). Oct 1972. Contract DA-31-124-ARO(D)-440. 34p. (NASA-CR-129087). NTIS.

Absolute cross sections were measured for the excitation of the NI(1134, 1164, 1168, 1200, 1243, and 1743A) multiplets by electron impact on atomic nitrogen. The presence of vibrationally excited molecular nitrogen in the discharged gas was confirmed, and its effect on the measurements is discussed. The ratio of the oscillator strengths of the 1200 and 1134 A resonance transitions is presented, as well as the branching ratio for the NI(1311/1164 A) multiplets. Striking differences in the distribution of intensity between the spectra of atomic nitrogen and molecular nitrogen excited by energetic electrons suggest an optical method for measuring the density of atomic nitrogen in the upper atmosphere. (auth) (STAR)

3752 (RLO–1388-200) ELECTRON LOSS IN HIGH-ENERGY OXYGEN–ION COLLISIONS. Burch, D.; Wieman, H.; Ingalls, W. B. (Washington Univ., Seattle. Dept. of Physics). 1973. 11p. Dep. NTIS $3.00.

The 90° electron spectra from oxygen-ion single collisions with Ar were measured at energies of 17 to 41 MeV and charge states of 3+ to 8+. A broad peak in the spectra is observed and identified as electrons lost from the incident ion. A simple model of the electron-loss process is described which supports the identification. (auth)

3753 THEORY OF MOLECULAR COLLISIONS. Sams, W. N. Houston, TX; Univ. of Houston (1972). 116p. University Microfilms Order No. 73-327.

Thesis (Ph. D.).

Elastic and inelastic (rotational excitation) cross sections for $e-H_2$ scattering in the energy range from .01 to .6 Ryd are obtained by performing close-coupling calculations. A conventional partial wave expansion is employed and the resulting coupled equations are solved by means of a numerical technique developed by Sams and Kouri. The T-matrix elements so obtained are combined according to the coupling rules for angular momenta to obtain the desired differential and total cross sections. A simple model interaction composed of short-range square wells plus smooth long-range terms is proposed and is used to calculate cross sections in the energy range of interest. The results of the calculation are discussed in terms of a model charge distribution and additional improvements are suggested. Considering the simplicity of the model the results compare favorably with experimental and other theoretical work. (Diss. Abstr. Int., B)

3754 ELECTRON DETACHMENT FROM NEGATIVE HYDROGEN IONS BY ELECTRON COLLISIONS USING THE BORN–OCHKUR APPROXIMATION. John, T. L.; Williams, B. (University Coll., Cardiff, Wales). Phys. Lett., 43A: No. 5, 463-464 (9 Apr 1973).

An analytical expression is given for the radial integral arising in the treatment of the collisional ionization of negative ions by the Born approximation. The method is illustrated with an application to H^-. (auth)

3755 ELECTRON IMPACT EXCITATION OF AUTO-IONIZING LEVEL IN Cs. Tiwary, S. N.; Rai, D. K. (Banaras Hindu Univ., India). Phys. Lett.; 43A: No. 5, 411-412(9 Apr 1973).

Cross sections for electron impact excitation to autoionizing level at 12.3 eV in Cs have been calculated in the simple Born

approximation. Hartree-Fock atomic orbitals appropriate to the Cs ground state have been used. The calculated contribution of autoionization is in satisfactory agreement with the estimate made earlier by Nygaard. (auth)

3756 SHELL-WISE PHOTOELECTRIC CROSS-SECTIONS OF 60-keV GAMMA RAYS. Rao, K. S.; Rao, B. V. T.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Indian J. Phys.; 46: No. 12, 576-577(Dec 1972).

The shell-wise photoelectric cross sections for copper, silver, and uranium at 60 keV are obtained by dividing the total photoelectric cross sections with the ratio total to shell. The total photoelectric cross sections are obtained by measuring the total gamma ray cross sections and subtracting the other theoretical partial cross section contributions. (JFP)

3757 EXTERNAL BREMSSTRAHLUNG PRODUCED BY BETA PARTICLES IN THIN FOILS. Mudhole, T. S. (Univ. of Karnatak, Dharwar, India). J. Phys., A (London); 6: No. 4, 533-539(Apr 1973).

The integrated external bremsstrahlung (EB) produced by beta particles from $^{90}Sr-^{90}Y$, ^{90}Y, ^{32}P, and ^{89}Sr sources in different thicknesses of Cu, Ag, Cd, Sn, and Pb targets is measured with a NaI(Tl) scintillation spectrometer. The external bremsstrahlung intensity increases rapidly with target thickness, but the increase of the intensity is not linear. This nonlinear increase of EB intensity is shown to follow an empirical relation of the type $t \exp(-\Sigma_B t)$, where t is the thickness of the target in mg cm^{-2} and Σ_B is a constant. Σ_B ($cm^2 mg^{-1}$) is found to be a constant and independent of the atomic number of the target. Σ_B is determined for $^{90}Sr-^{90}Y$, ^{90}Y, ^{32}P and ^{89}Sr beta sources. The values of Σ_B are found to be constant and agree with each other within 15 to 20% for these beta sources, showing that Σ_B is constant, independent of the atomic number of the target and also independent of the end-point energy of the beta spectrum. (auth)

3758 SOLUTION OF DIFFERENTIAL EQUATIONS FOR EXCHANGE MATRIX ELEMENTS IN HEAVY PARTICLE COLLISIONS. Parcell, L. A. (Univ. Laval, Quebec). Comput. Phys. Commun.; 5: No. 4, 283-293(Apr 1973).

The program SOLVE D. E. FOR MATRIX ELEMENTS written in FORTRAN IV for the IBM 370 computer is described for calculating a general one-electron two-center exchange integral in terms of which the matrix elements can be expressed for cross sections for atomic collisions using the impact parameter approximation. (JFP)

3759 DECELERATION OF ATOMS WITH ENERGIES OF ~20 TO 200 eV IN METALLIC MEDIA. Kaipov, D. K.; Kosyak, Yu. G.; Smirin, L. N.; Shubnyi, Yu. K. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 29-33(1972). (In Russian).

Nuclear resonance scattering of 1380, 1780, 1434, 1330, 1850, and 1534 keV γ quants by the nuclei ^{24}Mg, ^{28}Si, ^{52}Cr, ^{60}Ni, ^{88}Sr, and ^{140}Ce was studied. Metallic ^{24}Na, ^{28}Al, ^{52}V, ^{60m}Co, ^{88}Rb, and ^{140}La, respectively, were used as sources. Conclusions were drawn regarding the correlation of the deceleration parameter of recoil nuclei of the atoms in flight from their charges and interatomic distances in the crystalline lattices of the sources. (tr-auth)

3760 ELASTIC SMALL ANGLE SCATTERING OF IONS AT ATOMS IN THE HIGH ENERGY REGION. 1. Theoretical Results. Beier, H. J. (Technische Univ., Berlin). J. Phys., B (London); 6: No. 4, 683-696(Apr 1973).

In analysing the elastic small angle scattering of ions by atoms in the high energy region it is advantageous to separate the repulsive and the attractive terms of the interaction potential. Both terms dominate the scattering in different ranges of the scattering angle. The repulsive potential leads to undulations in the cross section which are found in the range of $\approx 10^{-4}$ to $\approx 10^{-3}$ rad for systems of $^7Li^+$ ions and rare gas atoms at energies about 30 keV. The undulations are caused by the diffraction of the matter waves at the atoms. With this knowledge a simple characteristic correlation between the positions of the undulation extrema and the parameters of the repulsive potential can be given. The undulation effect can be used for determining the repulsive potential term. The influence of the attractive forces between ions and atoms on the small angle scattering is studied for two different attenuated polarization potentials. The calculations show that this potential term has its main influence in the region below the undulation extrema. If the depth of the potential minimum is sufficiently large, the first minimum of the fast oscillations becomes measurable. (auth)

3761 DIFFERENTIAL SCATTERING CROSS SECTION FOR EXCITATION IN He^+Ne COLLISIONS. Gaussorgues, C. (Observatoire de Paris, Meudon, France). J. Phys., B (London); 6: No. 4, 675-682(Apr 1973).

The impact parameter method is used to investigate the excitation of the $(2p^6 3s)^1P$ of Ne in He^+Ne collision. It is assumed that excitation occurs mainly by a transition from the B^2 state to the excited c^2 state in the vicinity of the pseudo crossing of their respective potential energy curves. The potential parameters of Sidis and Lefebvre-Brion (J. Phys. B. Atom. Molec. Phys. 4: 1040-54(1971)) are adopted. The calculations which have been made at impact energies 0.7 and 1.58 keV are in very good agreement for 3 keV deg with the experimental results of Baudon et al (J. Phys. B. Atom. Molec. Phys.; 3: 207-29(1970)). Limitations of the methods used are discussed. (auth)

3762 ASYMPTOTIC SOLUTIONS OF THE COUPLE EQUATIONS OF ELECTRON-ATOM COLLISION THEORY FOR THE CASE OF SOME CHANNELS CLOSED. Norcross, D. W.; Seaton, M. J. (Univ. of Colorado, Boulder). J. Phys., B (London); 6: No. 4, 614-621(Apr 1973).

Solutions of the coupled equations for electron-atom collision theory, having known asymptotic forms, can be calculated using asymptotic expansions at some large values of r, say $r = r_p$ and r_{p+1}. At some smaller values of r, say $r = r_1$ and r_2, it is required to match the asymptotic solutions to solutions which are bounded at the origin. When some channels are closed, inwards integrations from (r_p, r_{p+1}) to (r_1, r_2) can give solutions which have poor linear independence at (r_1, r_2). It is shown that good linear independence can be obtained using a Fox-Goodwin technique for the solution of two-point boundary value problems. (auth)

3763 CALCULATION OF ELECTRONIC EXCITATION CROSS-SECTIONS FOR NATRIUM ATOM. Brandus, L. (Inst. of Physics, Bucharest). Rev. Roum. Phys.; 18: No. 2, 187-194(1973).

A method for the determination of excitation cross sections is considered. With the aid of this method the excitation cross section for the transition 3s-3p in the sodium atom is calculated. (1 table) (auth)

3764 LIBERATION OF POSITIVE IONS FROM SILVER SINGLE CRYSTALS UNDER HEAVY-ION BOMBARDMENT. Bhattacharya, R. S.; Karmohapatro, S. B. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Instrum. Methods; 109: No. 1, 191-193 (1973).

Positive ions liberated from (111) and (100) surfaces of silver single crystals bombarded by 23 and 15 keV $^{40}Ar^+$ and $^{20}Ne^+$ ions were studied as a function of crystal orientation. The yield of the total positive charge produced strong minima, whenever the incidence of primary ions was along the low-index directions or parallel to low-index planes. The angular half width at half depth of these minima was measured. Results are discussed in the light of the theory of Lindhard. (auth)

3765 SEMICLASSICAL SCATTERING MATRIX FOR TWO-STATE EXPONENTIAL MODEL. Bayfield, J. E. (Yale Univ., New Haven); Nikitin, E. E.; Reznikov, A. I. Chem. Phys. Lett.; 19: No. 4, 471-475(15 Apr 1973).

A semiclassical scattering matrix for the two-state problem with one nonadiabaticity region is discussed. The Stueckelberg phases for an exponential model are obtained and some limiting cases are considered. (auth)

3766 PHOTOIONIZATION OF SIMPLE HYDROCARBONS AT 73.6 TO 74.4 AND 58.4 nm. Comparison with Penning Ionization. Sieck, L. W.; Gorden, R., Jr. (National Bureau of Standards, Washington, D. C.). Chem. Phys. Lett.; 19: No. 4, 509-512(15 Apr 1973).

Ionic fragmentation patterns were determined for CH_4, CD_4, C_2H_2, C_2H_4, and C_3H_8 following photoabsorption at 73.6 to 74.4 (16.7 to 16.9 eV) and 58.4 nm (21.2 eV). These mass spectra were compared with previous spectra obtained via Penning ionization processes involving collisions of these same molecules with metastable Ne (16.6 to 16.7 eV) and He (19.8 to 20.6 eV). On the basis of this comparison it is concluded that the molecular ions produced in Penning ionization have a higher internal energy content than is produced by photoionization at the same energy. (auth)

3767 AUTOIONIZING TRANSITIONS IN N_2 AND H_2 PRODUCED BY ELECTRON IMPACT. Hicks, F. J.; Comer, J.; Read, F. H. (Univ. of Manchester, Eng.). J. Phys., B (London); 6: No. 4, L65-L69(Apr 1973).

Studies were made of autoionizing transitions in N_2 with excitation by low energy electron impact. Electron ejection is observed from states of the neutral molecule in the continuum region 16 to 19 eV giving levels of the $x\ ^2\Sigma_g^+$ state of N_2^+. Measurements are made of autoionizing states which gave previously

been detected using photon and high energy electron excitation. In addition new levels are observed which appear to be favoured by low energy electron excitation. (auth)

3768 SCATTERING OF ATOMS FROM SURFACES. 3. A Surface of Spheres. Beeby, J. L. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Phys., C (London); 6: No. 7, 1229-1241(12 Apr 1973).

A formalism is developed which enables the scattering of atoms from a surface of moving spheres to be calculated so that the influence of surface structure on scattering patterns can be investigated. Results are presented which show the intensity of diffracted peaks from a variety of surfaces and the behaviour of inelastic peaks as a function of incident parameters and surface structure. (auth)

3769 SINGLET S-WAVE ELECTRON–HYDROGEN SCATTERING. Madan, R. N. (North Carolina Agricultural and Technical Univ., Greensboro). Lett. Nuovo Cim.; 6: No. 13, 509-513(31 Mar 1973).

Various zero-order approximations to s-wave scattering of electrons by hydrogen atoms below the first excitation threshold are discussed. The s-wave singlet e–H phase shifts are found. (JFP)

3770 CIRCULAR VERSUS LINEAR POLARIZATION IN MULTIPHOTON IONIZATION OF HYDROGEN. DeWitt, R. N. (Naval Research Lab., Washington, D. C.). J. Phys., B (London); 6: No. 4, L93-L95(Apr 1973).

The ratio of circular to linear polarization cross sections for multiphoton ionization of hydrogen by intense electromagnetic fields is obtained. A cross over in dominance is seen to occur at large photon number; but this is offset by the cross section then being many orders of magnitude smaller than that for the dominant process. (auth)

3771 ISOTOPE EFFECTS IN THE PREDISSOCIATION OF THE $C^2\Sigma_u^+$ STATE OF N_2^+. Govers, T. R. (Paris Univ., Orsay, France); van de Runstraat, C. A.; de Heer, F. J. J. Phys., B (London); 6: No. 4, L73-L75(Apr 1973).

The "2nd negative" spectrum emitted by the $c^2\Sigma_u^+$ state of N_2^+ in an electron beam experiment is analysed for different nitrogen isotopes. It is found that in $^{29}N_2$ and $^{30}N_2$ the vibrational level $\nu' = 3$ to $\nu' = 7$ predissociate about six respectively ten times more slowly than in $^{28}N_2$. (auth)

3772 PHOTOIONIZATION RESONANCE PROFILE PARAMETERS OF THE 3s3p $^1P_1$ TWO-ELECTRON EXCITATION IN He I. Dhez, P.; Ederer, D. L. (National Bureau of Standards, Washington, D. C.). J. Phys., B (London); 6: No. 4, L59-L64 (Apr 1973).

The cross section profile of the 3s3p $^1P_1$ two-electron excitation has been measured in He I. The cross section was assumed to have the form $\sigma(E) = C(E) + [(E - E_0)\frac{1}{2}\Gamma a + (\frac{1}{2}\Gamma)^2 b/(E - E_0)^2 + (\frac{1}{2}\Gamma)^2]$ where the adjustable parameters, a, b, $\frac{1}{2}\Gamma$ and E_0 were determined by a least squares fitting process. The parameter values obtained in the experiment were: $a = 0.86 \pm 0.16$ cm^{-1}, $b = 0.27 \pm 0.13$ cm^{-1}, $\frac{1}{2}\Gamma = 65.9 \pm 7.0$ meV, $E_0 = 69.919 \pm 0.007$ eV. The Fano parameters q and α_a were determined from a and b and had the values 1.36 ± 0.20 and 0.32 ± 0.08 cm^{-1} respectively. (auth)

3773 ELECTRON-MOLECULE COLLISION IONIZATION IN HYDROGEN AND DEUTERIUM. Cowling, I. R.; Fletcher, J. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 6: No. 4, 665-674(Apr 1973).

The ionization of a gas molecule was experimentally studied by measurement of both the electron-molecule ionization cross section in an electron beam, Q_i, and the electron ionization coefficient of an electron swarm, α/N. The results are presented for both hydrogen and deuterium and a comparison of the theoretical values of α/N, calculated from the present values of Q_i using various electron energy distribution functions, $F(\epsilon)$, with the present experimental values of α/N in hydrogen, indicates which form of $F(\epsilon)$ is most probable in this gas. (auth)

3774 INELASTIC SCATTERING OF ELECTRONS AND PROTONS BY ATOMS AT INTERMEDIATE ENERGIES. Joachain, C. J.; Vanderpoorten, R. (Univ., Brussels). J. Phys., B (London); 6: No. 4, 622-641(Apr 1973).

The eikonal distorted wave theory is applied to the inelastic scattering of electrons and protons by atoms at intermediate energies. Absorption effects are explicitly taken into account in the optical potentials describing elastic scattering in the initial and final channels. Detailed numerical calculations are performed for the excitation of the n = 2 states of atomic hydrogen. (auth)

3775 CLASSICAL TREATMENT OF FAST ATOMIC COLLISIONS. Bates, D. R.; Snyder, R. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 4, 642-652(Apr 1973).

In the classical binary encounter approximation the period during which the field of the projectile nucleus acts on the electron, while that of the target nucleus does not, is infinite. A modification is introduced making this period finite. It leads to satisfactory results for capture in high energy H^+–H(1s) collisions, and it also leads to satisfactory results for ionization (particularly if allowance is made for the change in the potential energy of the electron in the field of the target nucleus caused by the transient interaction with the projectile nucleus). The classical binary encounter approximation fails in first order, to account for capture. Its success in the case of ionization is partly due to cancellation of errors from two unrelated sources. (auth)

Atomic Theory

3776 INTERATOMIC POTENTIALS. Torrens, I. M. New York; Academic Press, Inc. (1972). 257p. $15.00.

The topics discussed cover the nature of interatomic forces, atomic models, interatomic potentials based on Thomas–Fermi theory, empirical interatomic potentials, pseudopotential theory, pair potentials based on pseudopotential theory, atomic collision theory and interatomic potentials, experiments on the scattering of atoms and ions, liquid metal pair interaction potentials, and the application of interatomic potentials. (JFP)

3777 QUANTUM STRUCTURE OF THE RESONANCE EFFECTS CAUSED BY THE ACTION OF AN ALTERNATING MAGNETIC FIELD ON AN ATOMIC SYSTEM. Capeller, U. (Univ., Marburg, Ger.). Fortschr. Phys.; 20: No. 7, 423-469(1972). (In German).

The action of an alternating magnetic field on a spin system is studied first from the standpoint of quantum electrodynamics. The results are then compared with those derived by a semi-classical treatment of the problem. Finally, interconnections between the two approaches are analyzed. The conclusion is reached that the semi-classical treatment yields in every detail the same results as those derived by quantum electrodynamic methods. (HBG)

3778 VARIATIONAL PERTURBATION THEORY INVESTIGATIONS ON TWO-ELECTRON ATOMIC SYSTEMS. Midtdal, J. (Univ. of Oslo); Aashamar, K.; Lyslo, G. Phys. Norv.; 6: No. 2, 87-96(1972).

Four different types of auxiliary functions were investigated as to their flexibility, stability, and their ability to give satisfactorily converged expansion series for energies and wave functions. The various sets of basis functions were employed in variational perturbation theory calculations of the nonrelativistic energies of the states $1s2s^3S$ and $1s3s^3S$ in particular, and fairly good estimates of the nonlinear parameters entering the individual wave functions were determined. The numerical results are accompanied by illustrative figures. (auth)

3779 VARIATIONAL PERTURBATION THEORY INVESTIGATIONS ON TWO-ELECTRON ATOMIC SYSTEMS. Aashamar, K. (Univ. of Oslo); Midtdal, J.; Lyslo, G. Phys. Norv.; 6: No. 1, 21-31(1972).

An introductory description is given of a variational perturbation theory investigation undertaken to furnish nonrelativistic energies and wave functions for exited states with an accuracy comparable to that which was attained for ground states. Various types of auxiliary basis functions are defined, and general formulas for all the matrix elements necessary for handling the states $1sns^{3,1}S$ and $1snp^{3,1}P$ are presented. (auth)

3780 COORDINATE FREE ANALYSIS OF THE MODIFIED HYLLERAAS FUNCTIONALS FOR ESTABLISHING BOUNDS ON THE SECOND ORDER CORRECTIONS TO THE ENERGIES OF EXCITED STATES OF ATOMS. Sharma, C. S. (Birbeck Coll., London); Rebelo, I. J. Phys., A (London); 6: No. 4, 459-467 (Apr 1973).

Upper and lower bounds are established on the second-order energies of excited stationary states of an atom by a coordinate-free analysis of suitably modified Hylleraas functionals. The work proves more rigorously, and generalizes, some of the earlier results of Sharma (Proc. Phys. Soc.; 91: 50-3(1967) and J. Phys. A. Gen. Phys.; 2: 140-1(1969)). A misunderstanding regarding the correct orthogonality condition for the first-order wave function of an excited state is corrected. (auth)

3781 GENERAL PROGRAM TO CALCULATE ANGULAR MOMENTUM COEFFICIENTS IN RELATIVISTIC ATOMIC STRUC-

TURE. Grant, I. P. (Oxford Univ.). Comput. Phys. Commun.; 5: No. 4, 263-282(Apr 1973).

The program MCP written in FORTRAN IV for the ICL 1906A and IBM 370/165 computers is described for the calculation of the Slater integral coefficients in terms of which the matrix elements can be expressed. (JFP)

3782 SECOND-ORDER MAGNETIC HYPERFINE INTERACTIONS IN ONE-ELECTRON ATOMS. Connections Between the Schroedinger, Dirac, and Quantum Electrodynamical Perturbation Calculations. Latvamaa, E.; Kurittu, L.; Pyykkoe, P.; Tataru, L. (Univ. of Helsinki). J. Phys., B (London); 6: No. 4, 591-600(Apr 1973).

Second-order hyperfine interactions are considered for a one-electron atom, treating the nucleus as a point magnetic dipole of infinite mass and charge Z. The dominant contribution to the hyperfine splittings in the 1s and 2s states is found to arise from the ultra-relativistic continuum. In the high momentum limit the Schroedinger calculation gives a linear divergence while the Dirac and QED calculations give a logarithmic divergence. This explains why the nonrelativistic variational result of Gregson et al (J. Phys. B. Atom. Molec. Phys.; 3: 1195-1200 (1970)) is too large by a factor of 10^2. The Dirac result is $\frac{8}{9}$ of the QED result, $(\frac{8}{9})(\alpha/\pi)(\mu m/M)\ln(p_{max})$, because of a missing retardation term. The Schroedinger and Dirac residuals are in good agreement. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstract 3609.

3783 MHD ACCELERATION IN THE UNSTEADY EXPANSION OF A SHOCK TUBE DRIVER. Cashman, J. D. (Univ. of New South Wales, Duntroon, Australia). Aust. J. Phys.; 26: No. 1, 61-78(Feb 1973).

The isentropic unsteady expansion of the driver gas in a shock tube is made to pass through an MHD interaction. The interaction is tailored so as to produce a new isentropic unsteady expansion downstream with greater energy than the original, which will drive a new shock of greater but constant velocity. Illustrative examples are calculated. (auth)

3784 UNIVERSAL STABILITY OF STRATIFIED ROTATING CONDUCTING FLUIDS. Rudraiah, N.; Shanthakumar, M.; Chandrasekhara, B. C. (Bangalore Univ., India). Indian J. Phys.; 46: No. 12, 562-575(Dec 1972).

The nonlinear stability of rotating conducting fluids is investigated under the influence of magnetic field and Coriolis forces by applying energy methods. A universal stability estimate, namely a stability limit for motions subject to arbitrary nonlinear disturbances, is obtained. This universal stability estimate establishes the existence of an open region of certain stability near the origin of the cartesian plane depending on the different physical configurations of the problem. The universal stability limit is then improved using variational techniques. The results are then compared with the linear results of Chandrasekhar (1961). The effect of magnetic field and rotation, together or separately are found to have destabilizing influence on the configuration as opposed to the linear theory results of Chandrasekhar. (auth)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstracts 2745 and 3476.

3785 SEARCH FOR QUARKS USING A FLASH-TUBE CHAMBER. Ashton, F.; Cooper, D. A.; Parvaresh, A.; Saleh, A. J. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 4, 577-581 (Apr 1973).

A search for charge e/3 quarks was made in extensive air showers where the local electron density is greater than 40 m^{-2}. The apparatus was operated for 2570 hours, and no definite quark tracks were detected. The limit on the charge e/3 quark flux set by the present work is less than 8.0×10^{-11} cm^{-2} s^{-1} sr^{-1}. (auth)

Electromagnetic

Refer also to abstracts 2739, 4057, and 4113.

3786 (BNL-tr-535) SEPARATION OF VERY-HIGH-ENERGY PARTICLES BY THE TRANSITION-RADIATION METHOD. Alikhan'yan, A. I.; Belyakov, E. S.; Garibyan, G. M.; Lorikyan, M. P.; Markaryan, K. Zh.; Shikhylarov, K. K. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.) from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 6, 315-318 (1972). 9p. Dep. NTIS $3.00.

The transition radiation produced in foam plastic at electron energies from 1 to 4.5 GeV is studied. The foam plastic radiator length and electron energy dependence of the average number of photoelectrons per primary electron and the photoelectron distribution are shown. (JFP)

3787 (DESY-73/5) MEASUREMENT OF PROTON AND NEUTRON ELECTROMAGNETIC FORM FACTORS AT SQUARED FOUR-MOMENTUM TRANSFERS UP TO 3 $(GeV/c)^2$. Bartel, W.; Buesser, F. W.; Dix, W. R.; Felst, R.; Harms, D.; Krehbiel, H.; Kuhlmann, P. E.; McElroy, J.; Meyer, J.; Weber, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1973. 94p. Dep. NTIS (U. S. Sales Only) $6.75.

Electron-proton elastic scattering cross sections were measured at squared four-momentum transfers q^2 of 0.67, 1.00, 1.17, 1.50, 1.75, 2.33, and 3.00 $(GeV/c)^2$ and electron scattering angles θ_e between 10° and 20° and at about 86° in the laboratory. The proton electromagnetic form factors G_E^p and G_M^p were determined. The results indicate that G_E^p (q^2) decreases faster with increasing q^2 than G_M^p (q^2). Quasielastic electron-deuteron cross sections were determined at values of $q^2 = 0.39$, 0.565, 0.78, 1.0 and 1.5 $(GeV/c)^2$ and scattering angles between 10° and 12°. At $q^2 = 0.565$ $(GeV/c)^2$ data were also taken with $\theta_e = 35°$ and at $q^2 = 1.0$ and 1.5 $(GeV/c)^2$ with $\theta_e = 86°$. Electron-proton as well as electron-neutron scattering cross sections were deduced by the ratio method. The theoretical uncertainties of this procedure are shown to be small by comparison of the bound and free proton cross sections. The magnetic form factor of the neutron G_M^N derived from the data is consistent with the scaling law. The charge form factor of the neutron is found to be small. (auth)

3788 STUDY OF ELECTROPRODUCTION WITH A STREAMER CHAMBER FOR $0.3 < Q^2 < 1.5$ GeV^2, $m_p \leq W < 2.8$ GeV. Eckardt, V. (Deutsches Elektronen Synchrotron, Hamburg); Gebauer, H. J.; Joos, P.; Meyer, H.; Naroska, B.; Notz, D.; Podolsky, W. J.; Wolf, G.; Yellin, S.; Dau, H.; Drews, G.; Greubel, D.; Meincke, W.; Nagel, H.; Rabe, E. Nucl. Phys., B; B55: No. 1, 45-82(1973).

Electroproduction in the kinematical region $0.3 < Q^2 < 1.5$ GeV^2, $m_p \leq W < 2.8$ GeV was studied with a streamer chamber at DESY. The average multiplicity of charged hadrons is found to be somewhat smaller (~10%) than for photoproduction. The normalized π^- inclusive momentum spectra show less leading negative pions with increasing Q^2. The reaction $ep \rightarrow ep\pi^+\pi^-$ was analyzed: The mass distributions show strong Δ^{++} formation at low energies and dominant ρ^0 production for high energies. The cross sections for Δ^{++} and ρ^0 production were determined by maximum-likelihood fits. The ratio of ρ^0 to total inelastic production drops with Q^2 from $(16.6 \pm 0.8)\%$ at $Q^2 = 0$ to $(7.6 \pm 2.1)\%$ $[(4.3 \pm 2.9)\%]$ at $\langle Q^2 \rangle = 0.6$ [1.04] GeV^2. The t-distribution for events in the ρ mass region becomes increasingly flat with Q^2. The ρ^0 decay angular distribution was analyzed in the helicity system. Near threshold ($1.7 < W < 2$ GeV) the ρ^0 mesons are longitudinally polarized. For higher energies more transversely-aligned ρ^0 mesons are being produced. Under the assumption of s-channel helicity conservation the ratio $R = \sigma_L(ep\rho^0)/\sigma_T(ep\rho^0)$ is found to be 0.30 ± 0.14 at $\langle Q^2 \rangle = 0.6$ GeV^2, $\langle W \rangle = 2.3$ GeV. (auth)

3789 INCLUSIVE π^+ AND π^- DISTRIBUTION IN ELECTROPRODUCTION ON PROTONS. Dammann, I.; Driver, C.; Heinloth, K.; Hofmann, G.; Janata, F.; Karow, P.; Luke, D.; Schmidt, D.; Specht, G. (Duetsches Elektronen Synchrotron, Hamburg). Nucl. Phys.; B54: No. 2, 381-410(1973).

The inclusive pion spectra in the electroproduction reaction $ep \rightarrow e\pi^\pm$ + anything were investigated in a coincidence experiment at DESY. Data are presented from the kinematical region $0.1 < |q^2| < 0.8$ GeV^2 and $3.15 < W < 2.8$ GeV as a function of the transverse momentum squared p_T^2, the Feynman variable x, and the azimuth angle ϕ. The charge ratio π^+/π^- is given in terms of the variable q^2 and x. The inclusive spectra are compared with results from photoproduction. (auth)

3790 ELECTROPRODUCTION OF $\pi^-\Delta^{++}(1236)$ AND OF $\pi^+\Delta^0(1236)$ ON HYDROGEN. Dammann, I.; Driver, C.; Heinloth, K.; Hofmann, G.; Janata, F.; Karow, P.; Luke, D.; Schmidt, D.; Specht, G. (Deutsches Elektronen Synchrotron, Hamburg). Nucl. Phys.; B54: No. 2, 355-380(1973).

The electroproduction of a π-meson and of a $\Delta(1236)$ nucleon resonance on hydrogen, $ep \rightarrow e\pi\Delta(1236)$, was investigated in the two charge states $\pi^-\Delta^{++}$ and $\pi^+\Delta^0$ by measuring the scattered lepton and the produced π-meson in coincidence. The differential cross sections as functions of W, q^2, $t-t_{min}$ and $\phi_{\pi q}$ were determined. (auth)

3791 PHOTOPRODUCTION OF NEUTRAL PIONS OFF NEUTRONS IN THE ENERGY REGION BETWEEN 500 MeV AND 900 MeV. Hemmi, Y. (Kyoto Univ.); Inagaki, T.; Kikuchi, R.; Maki, A.; Miyake, K.; Nakamura, T.; Sasaki, A.; Tamura, N.; Yasumi, S.; Okuno, H. Nucl. Phys.; B55: No. 2, 333-362(1973).

The differential cross sections for the reaction $\gamma + n \rightarrow \pi^0 + n$ were measured at pion angles of 45°, 60°, 105°, 120° and 140° in the cms for photon energies of 500 to 900 MeV. Both π^0 meson and recoil neutron from a liquid deuterium target were detected with a pair of Cherenkov counters combined with lead spark chambers and a hodoscope consisting of 16 modules of plastic scintillation counters. The experimental results were compared with the recent phenomenological partial-wave analysis, and indicate that the ratio of the isoscalar part to the isovector part of the resonant amplitude of B_2-($N'(1520)(D_{13})$) is only about 0.2, and that in the $\gamma + n \rightarrow \pi^0 + n$ reaction there is no remarkable enhancement due to the $N'(1470)$ (P_{11}) resonance. (auth)

3792 ACOLLINEARITY AND RADIATIVE CORRECTIONS IN THE PROCESS $e^+e^- \rightarrow e^+e^-$. Calva-Tellez, E. (College de France, Paris). Lett. Nuovo Cim.; 6: No. 13, 519-523(31 Mar 1973).

Acoplanarity and acollinearity in angular distributions for the process $e^+ + e^- \rightarrow e^+ + e^-$ in colliding beams were studied. It is shown that there exists a fairly good agreement between theory and experiment as far as the analysis of acollinear events in terms of radiative corrections is concerned. (JFP)

3793 PHOTOPRODUCTION OF SINGLE $\pi^\pm$-MESONS ON NUCLEI AT $E_\gamma = 2$ AND 3 GeV. Parameters of Proton–Neutron Distribution in Nuclei. Abramyan, L. O.; Agan'yants, A. O.; Adamyan, F. V.; Vartapetyan, G. A.; Vat'yan, A. L.; Gevorkyan, S. R.; Danielyan, V. D.; Demekhina, N. A.; Israelyan, M. Kh.; Kazaryan, G. Kh.; Lebedev, A. N.; Manukyan, Zh. V.; Muradyan, E. G.; Sirunyan, A. M.; Khudaverdyan, A. G.; Khurshudyan, L. S. (Inst. of Physics, Erevan). Yadern. Fiz.; 16: No. 4, 739-747 (Oct 1972). (In Russian).

The $\gamma A \rightarrow A'\pi^\pm$ reaction on Be, C, Al, Cu, Ag, Pb and CH_2 nuclei was studied at photon energy $E_{\gamma max} = 2.05$ and 2.95 GeV and $|t| = 0.3$ and 0.58 $(GeV/c)^2$ respectively. The obtained values of Z_{eff} are independent of photon energy within the range from 2 up to 16 GeV (SLAC), this fact contradicts the predictions of vector dominance model. The ratio of π^-/π^+ cross sections was measured depending on A. It gives a possibility to obtain the value of the difference between the radii of proton-neutron distribution in Ag and Pb. (auth)

3794 OBSERVATION OF DOUBLE e^+e^--PAIR PRODUCTION. Balakin, V. E.; Bukin, A. D.; Kurdadze, L. M.; Onuchin, A. P.; Pakhtusova, E. V.; Serednyakov, S. I.; Sidorov, V. A.; Khabakhpashev, A. G. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 16: No. 4, 729-733(Oct 1972). (In Russian).

The results of first experiments on observation of double e^+e^- pair production ($e^+e^- \rightarrow e^+e^- + e^+e^-$) are presented. The experi-

ment has been performed on an experimental installation with colliding beams VEPP-2. The cross section for large angles of the produced particles was measured. The experimental results are in accordance with the theoretical calculations of Baier and Fadin. (auth)

Weak

3795 NEUTRINO RESONANCE ABSORPTION IN CRYSTALS. Andryushin, V. I. Yadern. Fiz.; 17: No. 2, 336-341(Feb 1973). (In Russian).

One of the possible methods of neutrino resonance absorption in crystals was considered. A monochromatic neutrino is obtained from ${}_1T^3 \rightarrow ({}_2He^3e^-)$-atom + $\bar{\nu}$ decay with production of ${}_2He^3e^-$ atomic system in the final state. A possibility of experimental observation of neutrino resonance absorption was exhibited, and an analysis of displacement and broadening of the monochromatic neutrino radiation line was presented. (auth).

3796 SEARCH FOR THE DECAY $K_S \rightarrow 2\mu$. Gjesdal, S.; (CERN, Geneva); Presser, G.; Steffen, P.; Steinberger, J.; Vannucci, F.; Wahl, H.; Filthuth, H.; Kleinknecht, K.; Lueth, V.; Zech, G. Phys. Lett.; 44B: No. 2, 217-220(16 Apr 1973).

A search for the decay $K_S \rightarrow 2\mu$ has given negative results. The 90% confidence upper limit for the branching ratio of 3.1×10^{-7} excludes the models of Christ and Lee, and of Dass and Wolfenstein, designed to explain the $K_L \rightarrow 2\mu$ problem. (auth)

3797 NEUTRINOS. Massey, H. (University Coll., London). Endeavour; 32: No. 116, 86-92(May 1973).

Thirty years ago it seemed certain that neutrinos, even if they existed, could not be a subject of experimental study, for their essential property was one of "nonobservability". Today, the situation is completely changed; not only is neutrino physics a flourishing branch of experimental physics, but the important role of neutrinos in astrophysics has been realized. In fact, the observation of neutrinos from extraterrestrial sources is a potentially very productive new branch of astronomy. (auth)

Strong (Baryon-induced)

Refer also to abstract 4042.

3798 (NP-19744) ENERGY-MOMENTUM CONSERVATION EFFECTS IN THE INCLUSIVE TWO PARTICLE CORRELATION FROM 18 GeV/c TO ISR ENERGY. Research Report No. 3/1973. Korosuo, O.; Sohlo, S. (Jyvaskyla Univ. (Finland). Dept. of Physics). Feb 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The experimental inclusive two-particle correlations are compared at different energies with the kinematical correlation function from an uncorrelated jet model with transverse momentum cut-off. At low energies the correlation data are found to depend strongly also on rapidity sum $(y_1 + y_2)$ in contrast to the dependence on only $(y_1 + y_2)$ predicted by the multiperipheral model. A negative correlation is found, which in addition to the positive central correlation is not due to energy-momentum conservation. A dynamical correlation length was determined at energies 18.5 to 500 GeV/c. The logarithmic increase in energy of the correlation in the central region which is found in the data makes consistent the large dispersion in multiplicity distribution observed at NAL and validity of short range correlation in the inclusive two-particle correlation function observed at ISR. (auth)

3799 ONE PION PRODUCTION IN pp COLLISIONS AT 16.2 GeV/c. Gnat, Y.; Alexander, G.; Benary, O.; Degan, S.; Grunhaus, J.; Levy, A.; Oren, Y.; Schlesinger, J. (Tel-Aviv Univ., Israel). Nucl. Phys.; B54: No. 2, 333-354(1973).

A study of pp interactions at an incident momentum of 16.2 GeV/c leading to two-prong non-strange final states was carried out in an exposure of the 2m CERN hydrogen bubble chamber. The cm angle and momentum distributions for the outgoing particles in the final states $pn\pi^+$ and $pp\pi^0$ are presented and discussed. These final states were analyzed in terms of quasi two-body final states – $N(N\pi)$, with the pion-nucleon system in an $I = \frac{1}{2}$ or $I = \frac{3}{2}$ state. A determination of these two isospin amplitudes and their interference term is then carried out. The reaction $pp \rightarrow pn\pi^+$ is found to be well described by a Reggeized exchange model, as well as by a double Regge-exchange model. (auth)

3800 CORRELATIONS ASSOCIATED WITH SMALL ANGLE PROTONS PRODUCED IN PROTON–PROTON COLLISIONS AT 31 GeV TOTAL ENERGY. Albrow, M. G.; Bagchus, A.; Barber, D. P.; Bogaerts, A.; Bosnjakovic, B.; Brooks, J. R.; Clegg, A. B.; Erne, F. C.; Gee, C. N. P.; Locke, D. H.; Loebinger, F. K.; Murphy, P. G.; Rudge, A.; Sens, J. C. (CERN, Geneva). Phys. Lett.; 44B: No. 2, 207-210(16 Apr 1973).

High energy inelastic protons with $x = 2p_L/s^{\frac{1}{2}} > 0.99$ observed in 15.3/15.3 GeV proton-proton collisions at the CERN ISR are accompanied by particles whose angular distribution is confined to a narrow cone in the opposite direction. In contrast, lower energy protons ($0.72 < x < 0.84$) are accompanied in addition, by particles emitted at larger angles. The ratio of the associated charged multiplicities is approximately 0.4. (auth)

3801 ANALYSIS OF THE REACTION $np \rightarrow d\pi^+\pi^-$ BELOW 3.5 GeV/c. Bar-Nir, I. (Univ., Heidelberg); Burkhardt, E.; Filthuth, H.; Oberlack, H.; Putzer, A.; Ang, P.; Alexander, G.; Benary, O.; Dagan, S.; Grunhaus, J.; Jacobs, L. D.; Levy, A.; Lissauer, D.; Stumer, I. Nucl. Phys.; B54: No. 1, 17-28(1973).

The reaction $np \rightarrow d\pi^+\pi^-$ was studied from threshold up to 3.5 GeV/c neutron beam momentum. Cross section values for this reaction are evaluated as a function of the beam momentum. The deuteron production features and the enhancement observed in the $d\pi$ mass spectrum at 2.17 GeV are adequately described in terms of an OPE model and nucleon–nucleon final-state interactions. (auth)

3802 SPECTRUM OF PROTONS PRODUCED IN pp COLLISIONS AT 31 GeV TOTAL ENERGY. Albrow, M. G.; Bagchus, A.; Barber, D. P.; Bogaerts, A.; Bosnjakovic, B.; Brooks, J. R.; Clegg, A. B.; Erne, F. C.; Gee, C. N. P. (CERN, Geneva). Nucl. Phys.; B54: No. 1, 6-16(1973).

Data are reported on the distributions in longitudinal and transverse momentum of protons produced in the range $0.5 < x < 1.0$ (x = Feynman variable) and $0.2 < p_T^2 < 1.8$ (GeV/c)^2 in proton–proton collisions at 31 GeV c.m. energy at the CERN ISR. The invariant inelastic cross section shows a peak at high longitudinal momenta. The shape of this peak suggests substantial production of states with masses up to at least 7 GeV. (auth)

3803 ELASTIC $\bar{p}d$ SCATTERING AT 5.55 GeV/c INCIDENT MOMENTUM. Braun, H. (Centre de Recherches Nucleaires, Strasbourg); Fridman, A.; Jegham, E.; Juillot, P.; Malko, J. A.; Voltolini, C.; Charlton, G. R.; Cooper, W. A.; Musgrave, B. Nucl. Phys.; B54: No. 1, 61-77(1973).

Based on 150,000 photographs taken at the ZGS with the 30 inch deuterium-filled chamber an analysis of the elastic $\bar{p}d$ scattering reaction is presented. Due to unrecorded small deuteron recoils only the elastic cross section in the four-momentum region $|t| > 0.03$ (GeV/c)^2 could be measured. Extrapolation towards small $|t|$ by two different methods gave two compatible estimates of the total elastic cross section. The differential cross section was analyzed by means of the Glauber formalism both with and without the effects due to the D-wave part of the deuteron wave function. The differential cross sections of np at 5.4 GeV/c and $\bar{p}n$ deduced from the data were compared and exhibit a crossover phenomenon. (auth)

3804 DIFFERENTIAL CROSS SECTIONS OF ELASTIC pp SCATTERING IN THE ENERGY RANGE 8 TO 70 GeV. Beznogikh, G. G.; Buyak, A.; Kirillova, L. F.; Morozov, B. A.; Nikitin, V. A.; Nomokonov, P. V.; Sandacz, A.; Shafranova, M. G.; Sviridov, V. A.; Troung Bien; Zayachki, V. I.; Zhidov, N. K.; Zolin, L. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., B54: No. 1, 78-96(1973).

Tables are presented of absolute differential cross sections of elastic pp scattering together with the values of the slope parameter B and the real-part parameter α, where $B = d(\ln d\sigma/dt)/dt$ and $\alpha = \mathrm{Re}\,A(0)/\mathrm{Im}\,A(0)$, and $A(0)$ is the amplitude of elastic pp scattering at $t = 0$. The cross-section data were obtained at the Serpukhov accelerator from 8 to 70 GeV in the $|t|$-range 0.0007 – 0.12 (GeV/c)^2. (auth)

3805 DIFFERENTIAL CROSS SECTIONS OF ELASTIC pd SCATTERING IN THE ENERGY RANGE 10 TO 70 GeV. Beznogikh, G. G.; Buyak, A.; Kirillova, L. F.; Morozov, B. A.; Nikitin, V. A.; Nomokonov, P. V.; Sandacz, A.; Shafranova, M. G.; Sviridov, V. A.; Troung Bien; Zayachki, V. I.; Zhidov, N. K.; Zolin, L. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; B54: No. 1, 97-108(1973).

We present tables of the absolute differential cross sections of elastic pd scattering. The cross-section data were obtained at the Serpukhov accelerator from 10 to 70 GeV in the $|t|$-range 0.002 – 0.2 GeV^2/c^2. The elastic pd scattering amplitude was parametrised as $A(t) = (d\sigma/dt)^{\frac{1}{2}}_{opt}\,(i + \alpha)\exp\frac{1}{2}(Bt + Ct^2)$. The values $\alpha = \mathrm{Re}A(0)/\mathrm{Im}A(0)$, B and C are presented in these tables. (auth)

Strong (Meson-induced)

3806 (COO–3130-TB-174) BACKWARD π^- CHARGE EXCHANGE AT INTERMEDIATE MOMENTUM. DeMarzo, C.;

Guerriero, L.; Nicolini, C.; Vaccari, E.; Waldner, F.; Chen, G. T. Y.; Fletcher, C. R.; Lanou, R. E. Jr.; Massimo, J. T.; Barton, D. S.; Nelson, B. A.; Rosenson, L.; Thern, R. E. (Brown Univ., Providence, R. I. Dept. of Physics; Brookhaven National Lab., Upton, N. Y.). 1972. 13p. (CONF-720954-20). Dep. NTIS $3.00.

From 16th international conference on high energy physics; Batavia, Illinois, USA (6 Sep 1972).

The differential cross sections for $\pi^- + p \rightarrow \pi^0 + n$ interactions at 3.5 to 6.0 GeV/c in the background hemisphere are found. (JFP)

3807 (JINR-P1-6988) INVESTIGATION OF THE $\pi^-p \rightarrow \pi^+\pi^-n$ REACTION NEAR THRESHOLD. Batusov, Yu. A.; Bunyatov, S. A.; Gulkanyan, G. R.; Kurbatov, V. S.; Sidorov, V. M.; Yarba, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

About 500 events of the $\pi^-p \rightarrow \pi^+\pi^-n$ reaction in the energy range of (200 to 260) MeV were analyzed by the maximum likelihood method on the basis of theory of three particle production near threshold (Gribov, Anselm, Anisovich). A simple form of the matrix element square is obtained, which describes satisfactorily the total amount of experimental data $|M|^2 = |\lambda|^2\{1 + C[K_{12}^2 - (1/2)E]\}$ the value of the modulus square of the reaction amplitude at the threshold being $|\lambda|^2 = 4.5 \pm 0.6$ and the slope parameter in spectrum over the square of relative momentum K_{12}^2 of two pions $C = 3.7 \pm 0.6$. The dependence of the reaction cross section on the emitted energy $\sigma = \rho^2(E/m_\pi)^2$, where $\rho^2 = (0.38 \pm 0.05)$ mb, is obtained. The contributions of nonanalytical (linear, square, cubic) terms, containing the $\pi\pi$-scattering length a_0, to the differential cross sections are calculated. (auth)

3808 (LBL-1051) STRANGE-PARTICLE PRODUCTION IN π^+d INTERACTIONS AT 2.7 TO 4.2 GeV/c. Hoch, P. L. (California Univ., Berkeley. Lawrence Berkeley Lab.). 16 Oct 1972. Contract W-7405-eng-48. 100p. Dep. NTIS $7.00.

Thesis. Part 1.

Strange-particle production in a π^+d exposure of the 72-inch bubble chamber is reported. The total exposure size was ≈22 events/μb at 2.7 to 4.2 GeV/c. A conventional Bevatron π^+ beam was used; the importance of the proton contamination (10 to 25%) is discussed. The film was scanned for all Λ and K^0 topologies; after a thorough measuring and remeasuring process a final sample of 18362 events was obtained. Each event was assigned to the most likely final-state hypothesis on the basis of the badness function, a modification of the χ^2 with parameters depending on the production constraint class of each fit. These parameters were chosen after examination of the missing mass, decay angles, and similar distributions. The motivation for this method, and the quality of the final separation, are discussed. A standard fitting program was used, treating an invisible spectator proton as quasi-measured. The usual fiducial cuts and weights were applied. Various properties of the spectator-momentum distributions are discussed. Tallies and approximate cross sections are presented for each final state. (auth)

3809 COHERENT GENERATION OF $2\pi^-\pi^+$ SYSTEM ON NUCLEI. Vasil'kova, A. D., Gornov, M. G.; Kirillov-Ugryumov, V. G.; Protasov, V. P.; Sergeev, F. M. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 17: No. 2, 327-335(Feb 1973). (In Russian).

Production of three mesons $2\pi^-\pi^+$ on nuclei by π^- mesons with momentum 3.9 GeV/c was studied with the help of a 105 cm heavy liquid bubble chamber. The cross section for the coherent reaction was found to be equal to 626 ± 288 μbarn/nucleus. An existence of a "leader" was established for this process. A set of experimental data shows that a considerable part of coherent reactions may be explained by diffraction dissociation of a primary particle into three uncorrelated π mesons in nucleus field (pion bremsstrahlung). Diffraction dissociation ρ and π mesons is also possible. (auth)

3810 DIFFERENCES OF TOTAL CROSS SECTIONS FOR MOMENTA UP TO 65 GeV/c. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A. (Inst. of High-Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 17: No. 2, 309-326(Feb 1973). (In Russian).

Total cross sections for π^-, K^-, and $\bar{p}$ on protons and deuterons were measured in the momentum range 15 to 65 GeV/c. Total cross sections for particle interactions with neutrons were determined with an energy dependent Glauber correction. Using the positive particle data obtained earlier with the same experimental apparatus, the differences of total cross sections for particles and antiparticles as well as for particles belonging to the same isospin multiplet were calculated. The measured total cross sections and their differences are in agreement with relations predicted by quark and Regge pole models. (auth)

3811 ANALYSIS OF THE REACTION BY DIFFRACTION AND PION EXCHANGE IN THE PROCESS $K^-p \rightarrow pK^-\pi^+\pi^-$. Markytan, M. (Institut fuer Hochenergiephysik, Vienna). Fortschr. Phys.; 20: No. 4, 201-249(1972). (In German).

In the various two- and three-particle systems, resonance production is studied at 10 GeV/c for the reaction $K^-p \rightarrow pK^-\pi^+\pi^-$. The general spin structure in the $K^-\pi^+\pi^-$ and $p\pi^+\pi^-$ systems is analyzed. From the angular distribution and from the direction of momenta in the rest state of the three-particle system, partial waves are projected, the momenta of which allow conclusions about the existing spin conditions. (HBG)

3812 REACTIONS $K^-p \rightarrow K^{*-}$ + NUCLEON AT 3.13 AND 3.3 GeV/c. Clark, A. G.; Lyons, L.; Radojicic, D. (Nuclear Physics Lab., Oxford). Nucl. Phys., B; B54: No. 2, 432-462(1973).

Results are presented of a 12 event/μb bubble-chamber experiment; the reactions discussed in detail are $K^-p \rightarrow K^*(890)^-p$, $K^*(1420)^-p$ and $K^*(890)^-\Delta^+$. The $K^*(890)^-p$ channel is dominated by the forward peak. The suggestion of flattening at $\cos\theta = 1$ is more pronounced in $(\rho_{11} + \rho_{1-1})\, d\sigma/dt$, which is mainly natural-parity exchange. Pseudoscalar exchange contributes to $\rho_{00}]\, d\sigma/dt$; this is more sharply peaked in t. The value of $(\rho_{11} - \rho_{1-1})d\sigma/dt$ is somewhat larger than the upper limit from the dominant natural-parity exchange. There is significant structure in $\rho_{00}^H d\sigma/dt$ at $t \approx -0.6$ (GeV/c)^2. The $K^*(1420)^-p$ channel is much more pronounced at 3.3 GeV/c than at 3.13 GeV/c, but is not markedly peripheral. The width of the $K^*(1420)$ in the 3.3 GeV/c data is 42 ± 12 MeV/c^2. The cross section for $K^* - \Delta^+$ agrees with that expected from $K^+p \rightarrow K^*\Delta$, assuming a single t-channel exchange. The measured density matrix elements are consistent with a strong pseudoscalar exchange. (auth)

3813 PION-DEUTERON SCATTERING NEAR THE 3-3 RESONANCE. Gabathuler, K.; Cox, C. R.; Domingo, J. J.; Rohlin, J.; Tanner, N. W.; Wilkin, C. (CERN, Geneva). Nucl. Phys.; B55: No. 2, 397-407(1973).

The elastic scattering of positive pions by deuterium was studied using a scintillating target to detect the recoil deuteron. In addition to the angular distribution measured for 256 MeV incident energy, the energy variation of the fixed angle cross section ($\theta_{lab} = 160°$) was determined between 141 MeV and 256 MeV. The former is in qualitative agreement with a simple multiple-scattering calculation, but the energy dependence is poorly reproduced. (auth)

3814 REACTION $\pi^+p \rightarrow (p\bar{n})p$ AT 13 GeV/c. Gaidos, J. A.; Dulude, R. S.; McIlwain, R. L. (Purdue Univ., Lafayette, IN). Nucl. Phys.; B55: No. 1, 29-32(1973).

The cross section for the reaction $\pi^+p \rightarrow (p\bar{n})p$ was measured to be 39 ± 5μb at 13 GeV/c. The production process is consistent with a one-pion-exchange approximation and the $p\bar{n}$ mass spectrum is remarkably similar to the peripheral $p\bar{p}$ mass spectrum recently reported. (auth)

3815 STUDY OF THE REACTIONS $K^-p \rightarrow \bar{K}^0\pi^-p$ AND $K^-p \rightarrow K^{*-}(890)p$ AT 8.25 GeV/c. Athens-Democritus-Liverpool Vienna Collaboration. Nucl. Phys.; B55: No. 1, 15-28(1973).

A variation of the model proposed by Plahte and Roberts is used to fit data from the reaction $K^-p \rightarrow \bar{K}^0\pi^-p$ at 8.25 GeV/c. The channel $K^-p \rightarrow K^{*-}p$ is also studied in some detail and the energy dependence of the cross section is discussed. The behavior of the differential cross sections and of the density matrix elements of K^* in the G-J frame as function of t′ suggests dominance of vector exchange with a small π-exchange contribution. The density matrix elements are also given in the helicity frame and a fit to the Harari model supports the dominance of natural-parity exchange and of the helicity non-flip amplitude at the nucleon vertex. (auth)

3816 MEASUREMENT OF THE BRANCHING RATIOS OF THE A_2^- MESON PRODUCED IN 3.9 GeV/c $\pi^-\rho$ INTERACTIONS. Chaloupka, V.; Dobrzynski, L.; Ferrando, A.; Losty, M. J.; Montanet, L.; Paul, E.; Yaffe, D.; Zieminski, A. (CERN, Geneva). Phys. Lett.; 44B: No. 2, 211-216(16 Apr 1973).

The branching fractions of the A_2^- meson, produced in the reaction $\pi^-p \rightarrow pA_2^-$ at 3.9 GeV/c incident momentum were measured. The rates for the $\eta\pi$ and $K\bar{K}$ modes relative to $\rho\pi$ are 0.211 ± 0.044 and 0.056 ± 0.014, respectively. The upper limit for the $\eta'\pi$ mode is the 90% confidence level. Also an $\omega\pi\pi$ decay of the A_2^- was sought, and the data are consistent with a rate of 0.10 ± 0.05, relative to $\rho\pi$. (auth)

3817 $K^+\pi^-$ ELASTIC SCATTERING CROSS SECTION AS OBSERVED IN $K^+p \rightarrow K^+\pi^-\Delta^{++}$ FROM 3 TO 13 GeV/c. Linglin, D. (CERN, Geneva). Nucl. Phys.; B55: No. 2, 408-426(1973).

The four-body reaction $K^+p \rightarrow K^+\pi^-\Delta^{++}$ is analyzed in a sample of 77,300 bubble chamber events of $K^+p \rightarrow K^+\pi^-\pi^+p$ for beam momenta from 2.5 to 12.6 GeV/c to study the $K^+\pi^-$ elastic scattering cross section. The relative merits of several analytic continua-

tions to the pion pole are discussed. Maximum likelihood method is used and, for each experiment fits are performed simultaneously over the whole range of the $M(p\pi^+)$, $m(K^+\pi^-)$ and t variables. The $K^+\pi^-$ cross section is parametrized in terms of the down solution for the s-wave, a p-wave resonating at the K*(890) and a d-wave resonating at the K*(1420). Fitted values are obtained for the four-body cross section, the s-wave contribution to the $K^+\pi^-$ cross section, and the masses and widths of the K*(890) and K*(1420). (auth)

3818 POLARIZATION IN $\pi^+p \to K^+\Sigma^+$ BACKWARD SCATTERING AT 3.5 GeV/c. Bradamante, F.; Conetti, S.; Daum, C.; Fidecaro, G.; Fidecaro, M.; Giorgi, M.; Kalmus, G.; Penzo, A.; Piemontese, L.; Schiavon, P.; Stairs, D.; Vascotto, A. (CERN, Geneva). Phys. Lett.; 44B: No. 2, 202-206(16 Apr 1973).

In a counter and wire spark chamber experiment with a polarized target, backward kaons were detected, and the Σ^+'s identified by a missing-mass technique. An average polarization of -0.08 ± 0.05 was found for $-0.2 < u < 0.1$ GeV^2. (auth)

3819 S-WAVE STRUCTURE IN THE Kπ SYSTEM. Cords, D. (Purdue Univ., Lafayette, IN); Carmony, D. D.; Garfinkel, A. F.; Loeffler, F. J.; Rangan, L. K.; Lander, R. L.; Pellett, D. E.; Yager, P. M.; Meiere, F. T.; Yen, W. L. Nucl. Phys.; B54: No. 1, 109-116(1973).

The Kπ spectrum (4,827 events) of the reaction $K^+n \to K^+\pi^-p$ was analyzed at 9 GeV/c and evidence of a broad S-wave enhancement was found which may be interpreted as a resonance. For production of Kπ masses above 890 GeV/c^2, the dominance of pion exchange was assumed. (auth)

3820 Λ^0 PRODUCTION IN π^-p INTERACTIONS AT 20 GeV/c. Balea, E.; Balea, O.; Berceanu, S.; Coca, C.; Mihul, A.; Sabau, M. (Inst. for Atomic Physics, Bucharest). Nucl. Phys.; B54: No. 1, 189-198(1973).

Lambda production in 20 GeV/c π^- interactions in hydrogen is studied. The distributions of the Λ^0 and pion c.m. production angle, transverse momentum and c.m. longitudinal momentum as functions of the charge multiplicity are discussed. The effective-mass distribution are also studied and it is found that Y**(1385) production occurs in 18% of the interactions. (auth)

3821 STUDY OF KAON PRODUCTION BY 20 GeV/c π^- MESONS ON PROTONS. Balea, E.; Balea, O.; Berceanu, S.; Coca, C.; Mihul, A.; Sabau, M., (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 18: No. 2, 143-150(1973).

Kaon production in 20 GeV/c π^--interactions on protons is studied. The kinematical behavior of the secondaries as function of charge multiplicity, as well as the production of resonances are discussed. (auth)

3822 TWO-BODY FINAL STATES IN K^-p INTERACTIONS AT 14.3 GeV/c. Miller, R. J. (Rutherford High Energy Lab., Chilton, Eng.); Paler, K.; Phelan, J. J.; Shah, T. P.; Chaurand, B.; Drevillon, B.; Labrosse, G.; Lestienne, R.; Linglin, D.; Salmeron, R. A.; Barloutaud, R.; Borg, A.; Louedec, C.; Pierre, F.; Spiro, M. Lett. Nuovo Cim.; 6: No. 13, 491-496(31 Mar 1973).

Differential cross sections are given for K^- + p interactions at 14.3 GeV/c in a bubble chamber with $n\overline{K}^0$, $\Lambda\pi^0$, $\Sigma^+\pi^-$, and $\Sigma^+(1385)\pi^-$ final states. Also total cross sections are given for $\overline{K}^0\Delta^0$, $\Lambda\eta$, $\Lambda\eta'(958)$, $\Lambda\varphi^0$, $\Lambda\omega$, and $\Lambda\phi$ final states. The Λ and Σ^+ polarization and the $\Sigma^+(1385)$ density matrix elements are also found. (JFP)

3823 INCLUSIVE SINGLE-PARTICLE DISTRIBUTIONS IN $\pi^\pm p$ REACTIONS AT 8 AND 16 GeV/c. Aachen-Berlin-Bonn-CERN Krakow-Heidelberg-Warsaw Collaboration Nucl. Phys.; B54: No. 1, 141-160(1973).

Invariant single-particle cross sections for pion and proton production in $\pi^\pm p$ interactions at 8 and 16 GeV/c are presented in terms of integrated distributions as functions of x, reduced rapidity ξ and $p_\perp^2$, and also in terms of double differential cross sections $E\,d^2\sigma/(dx\,dp^2)$ and $d^2\sigma/(d\xi\,dp_\perp^2)$. A comparison of π^+ and π^- induced reactions is made and the energy dependence is discussed. It is shown that the single-particle structure function cannot be factorized in its dependence on transverse and longitudinal momentum. For the beam-unlike pion, there is an indication for factorizability in terms of rapidity and transverse momentum in a small central region. (auth)

Particle Interactions and Properties (Theoretical)

General

3824 (ITF-72-103-E) FINITE-ENERGY UPPER BOUND FOR THE TOTAL CROSS-SECTION. Lomsadze, Yu. M.; Drobnich, V. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00

An upper bound for σtot(S) in the terms of a(S) = σd(S)/σtot(S) and a logarithmic derivative imaginary part of the forward scattering amplitude is obtained by the generalized Lagrangian multiplier rule. Unitarity and the fact that the experimental amplitude is expanded in partial waves are used. The result is valid for finite energies S and, as a tool to experimentally verify the principles of theory, strengthens the MacDowell–Martin upper bound in the region $a(S) \geq 2/3$. (auth)

3825 POSSIBILITY FOR CONSTANT TOTAL CROSS SECTION IN MULTIPERIPHERAL MODELS. Levin, E. M.; Ryskin, M. G. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 2, 388-406(Feb 1973). (In Russian).

A number of multiperipheral models, where alongside with π-meson exchange account is made of ρ and ω reggeons, were constructed. Owing to this fact it appeared to be possible to obtain total cross section of order 20 to 40 mbn and multiplicity of produced π-mesons ~1 ln s. The amplitudes of particle scattering at comparably low energies used agree with experimental data, and if the latter ones are not available, then with estimations, obtained from dual models. Characteristic general properties of such multiperipheral models are discussed. (auth)

3826 IF CHARM PARTICLES EXIST, CAN THEY BE DETECTED? Snow, G. A. (Laboratorie de Physique Theorique et Hautes Energies, Paris). Nucl. Phys.; B55: No. 2, 445-454(1973).

Arguments are presented in favor of the existence of "charm" particles, that is, hadronic states not classifiable in the usual three-quark model of Gellmann and Zweig. The three-triplet scheme of Han-Nambu is the most promising but, far from unique, theoretical structure for such particles. Assuming, for any of these models, that the charm quantum number is conserved in strong and electromagnetic interactions, but not in weak interactions, limits are deduced from past experiments on the possible minimum mass of charm particles and the maximum charm-changing four-fermion coupling constant. Finally several possible experimental methods of searching for charm particles are discussed. Unfortunately none are certain to discover them even if they do exist with masses less than a few GeV. (auth)

3827 LIGHT-CONE STRUCTURE OF VERTEX FUNCTIONS FOR COMPOSITE FIELDS. Ciafaloni, M. (CERN, Geneva); Menotti, P. Nucl. Phys.; B54: No. 2, 483-508(1973).

Vertex functions for composite fields are defined in a model field theory both on and off mass shell. Light-cone dominance at large momentum transfer is shown to hold, by the compositeness assumption, for the off-shell vertex function. On the other hand, it is in general untrue that the elastic form factor probes light-like distances between the constituents inside the nucleon. The relevant light-cone singularity (in the relative space–time separation x) is less important in this case than the large x_0 behavior of the wave function at fixed x^2. It is found however that, under some conditions, the light-cone singularity determines the large x_0 behavior of the wave function, and therefore the large q^2 behavior of the form factor. For composite particles described by a Bethe-Salpeter equation, this result is equivalent to the known fact that at large q^2 the form factor depends on the binding interaction at small distances. A relation similar to that of Drell-Yan-West is finally established between the asymptotic behavior of the elastic form factor and the threshold behavior of the absorptive part of the vertex scaling function. (auth)

3828 MULTIPOMERON PRODUCTION OF SHOWERS AT HIGH ENERGY. Ter-Martirosyan, K. A. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 44B: No. 2, 179-182 (16 Apr 1973).

Cross section of the multipomeron production of heavy showers is calculated and found at very high energy in the form $\sigma'_{AB} = [1-(s_0/s)^\gamma]\sigma^{tot}_{AB}$. It is shown that the multiperipheral part of the total cross section decreases at $s \to \infty$; $\sigma^{(0)}_{AB} = \sigma^{tot}_{AB} - \sigma'_{AB} = (s_0/s)^\gamma \cdot \sigma^{tot}_{AB}$ where the constant γ can be obtained from ISR data on proton spectra. It is found to be numerically very small $\gamma \sim 10^{-2}$. It follows that at accessible energies the value of $\sigma'_{AB} \approx (\gamma \ln s/s_0) \cdot \sigma^{tot}_{AB}$ must be small, logarithmically increasing with energy. This prediction can be checked experimentally on new accelerators. (auth)

3829 APPLICATION OF A PARAMETER-FREE REGGEIZED ABSORPTION MODEL TO SPIN-2^+ PRODUCTION. Collins, P. A. (Imperial Coll. of Science and Tech., London); Hartley, B. J.; Moore, R. W.; Moriarty, K. J. M. J. Phys., A (London); 6: No. 4, 506-532(Apr 1973).

A reggeized absorption model with no free parameters to be fitted to the data under consideration is applied to spin-2^+ production reactions. The differential cross section and spin density

matrix elements are well represented by the model for pion dominated reactions but less well for processes not proceeding by pseudoscalar exchange. (auth)

3830 FASTER-THAN-LIGHT INERTIAL FRAMES AND TADPOLES. II. Field Theory: Noninteracting, Interacting Tachyons and Tadpoles. Goldoni, R. (Univ., Pisa, Italy). Nuovo Cim., 14A: No. 3, 527-547(1 Apr 1973).

A field theory for spinless, noninteracting tachyons is developed. The result is a "fast" theory in which the roles of the first and fourth components of the space-time four-vector and of the four-momentum are interchanged with respect to the corresponding "slow" theory. Then the interactions between bradyons and tachyons are formally developed. Coherently with the results of a previous paper, the propagator constructed with a slow and a fast field represents a spurion. In this way the tadpoles are produced dynamically, without supposing a nonzero vacuum expectation value of the fields, slow or fast. Furthermore in order to explain the break-down of the "slow" symmetries some massless particles must be hypothesized. (auth)

3831 LIGHT-CONE COMMUTATORS OF STRESS-TENSOR COMPONENTS. Gatto, R. (Univ., Rome); Sartori, G. Nucl. Phys.; B54: No. 1, 117-140(1973).

The commutator $[\theta_{\mu\nu}(x), \theta_{\rho\sigma}(0)]$ among components of the stress tensor is studied in the limit $x^2 \to 0$. The related Bjorken limit of virtual graviton scattering is studied with special attention to its positivity restrictions and the ensuing conditions on the commutator. A complete discussion of scaling for virtual graviton scattering, of the sum rules from equal-time commutators, and of the conditions implied by positivity on the scale dimensions of the symmetry-breaking terms is given. (auth)

3832 RIGOROUS DETERMINATION OF THE SPIN-0–SPIN-$\frac{1}{2}$ ELASTIC SCATTERING AMPLITUDES FROM EXPERIMENTAL DATA AND UNITARITY. Alvarez-Estrada, R. F. (Junta de Energia Nuclear, Madrid), Carreras, B. (Nucl. Phys., B54: No. 1, 237-262(1973).

The contraction-mapping principle is used to study rigorously the elastic unitarity equations for the scattering of a spin-0 particle by a spin-$\frac{1}{2}$ particle when the unpolarized differential cross section $d\sigma/d\Omega$ and the polarization P at fixed energy below the first inelastic threshold are known from experiment. It is shown that when $d\sigma/d\Omega$, P and the region where the scattering amplitudes are searched are suitably restricted, the scattering amplitudes exist, are unique and can be found by iterating the unitarity equations. Besides, there are other solutions outside that space associated with well-known ambiguities. It is shown that those ambiguities are solved by measuring the parameters R and A and the sign of the real part of the forward amplitude. (auth)

3833 UNCORRELATED JET MODEL FOR PIONIZATION AND CORRELATIONS IN INCLUSIVE REACTIONS. Karczmarczuk, J. (Jagellonian Univ., Krakow). Lett. Nuovo Cim.; 6: No. 13, 524-526(31 Mar 1973).

An attempt is made to verify whether the two-component model with pionization described by the uncorrelated jet model can serve as a reliable model for the multiplicity spectrum in inclusive reactions. It is found that either one cannot neglect the dynamic correlations in pionization or the contribution of the diffraction dissociation to the high multiplicity channels is meaningful and a distinction between pionization and diffraction based only on a simple inspection of the multiplicity distribution becomes difficult. (JFP)

3834 THEORY OF NEUTRAL GAUGE FIELD WITH SPONTANEOUS SYMMETRY BREAKDOWN. Tyutin, I. V.; Fradkin, E. S. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 16: No. 4, 835-853(Oct 1972). (In Russian).

Theory of neutral gauge field interacting with the scalar one, whose square of bare mass is negative is considered. It is shown that in such a model the solution with a spontaneous symmetry breakdown is realized as a result vector meson gets a mass. With the help of the Ward identity the gauge invariance of renormalized theory and its unitarity in the physical space of the states of massive vector and massive scalar particles were proved. A set of gauge independent parameters defining the renormalized theory is given. The self-consistency equation defining the possibility for the existence of a solution with spontaneous symmetry breakdown is obtained. (auth)

3835 FASTER-THAN-LIGHT INERTIAL FRAMES AND TADPOLES. I. Classical Theory: Superluminal Transformations and Possible Interactions Between Tachyons and Slow Particles. Goldoni, R. (Univ., Pisa, Italy). Nuovo Cim.; 14A: No. 3, 501-526(1 Apr 1973).

The possibility of describing particles that travel faster than light within the special theory of relativity is investigated, introducing faster-than-light inertial frames and extending the principle of relativity to all inertial frames, slow and fast. The direct consequence of this hypothesis, which imposes a complete symmetry between slow and fast worlds, is that tachyons and bradyons can exchange only internal quantum numbers. Furthermore this symmetry allows us to develop a kinematics of faster-than-light particles in which the proper mass of a tachyon is interpreted by a real number, even if not corresponding to any possible direct observation. (auth)

3836 LECTURES ON ELEMENTARY PARTICLES AND QUANTUM FIELD THEORY. 1970 Brandeis University Summer Institute in Theoretical Physics. Volume 2. Deser, S.; Grisaru, M.; Pendleton, H. (eds.). Cambridge, MA; Massachusetts Institute of Technology Press (1970). 308p. $6.95.

Separate abstracts are prepared for the five lectures included. (LBS)

For abstracts of individual chapters see: 3888, 3900, 3949, 4470, and 4471.

Electromagnetic

Refer also to abstracts 3792 and 3969.

3837 (COO-1545-117) NEUTRINO CHARGE RADIUS IN A MODEL OF WEAK AND ELECTROMAGNETIC INTERACTIONS. Aubrecht, G. J. II; Tanaka, K. (Ohio State Univ., Columbus. Dept. of Physics). 1972. Contract AT(11-1)-1545. 13p. Dep. NTIS $3.00.

A modified SO(3) model of weak and electromagnetic interaction symmetry is introduced. The model is renormalizable and reproduces the usual theory of weak interactions. Four additional heavy leptons and five additional quarks are necessary. The electromagnetic charge radius of the neutrino is calculated in the ξ-limiting procedure and a finite result is found. (auth)

3838 (COO-2271-1) W BOSON PAIRS, THEIR PHOTOPRODUCTION AND DECAY. Sathe, A. P. (Columbia Univ., New York. Dept. of Physics). 1972. 42p. Dep. NTIS $4.25.

The photoproduction of W pairs was studied, obtaining explicitly the amplitudes for various spin states of the W's. It is found that total cross sections grow rapidly with energy of incident photon. Also for an assumed value of the anomalous moment of the W to be equal to one, the W bosons tend to be transversely polarized. Further, the leptonic decay of the W pair is calculated including the interference from different spin states of the two W bosons. The differential cross section with respect to the transverse component of the sum of the laboratory momenta of the two decay charged leptons is obtained. It is found that even for high values of this momentum component, the differential cross section decreases with increasing assumed mass of the W boson. (auth)

3839 (LNF-72/55) PHOTOPRODUCTION OF PIONS ON NUCLEONS IN THE $\Delta(1236)$ RESONANCE REGION. Jurewicz, A. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 13 Jun 1972. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

Lectures are given on the determination of the multipoles M_{1+}^{3} and E_{1+}^{3} in the resonance region and the problem of the presence of the isotensor electromagnetic current in photoproduction. (JFP)

3840 (LNF-72/105) HOW TO MEASURE THE DIMENSION OF THE PARTON FIELD. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 11 Dec 1972. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that the anomalous dimension of the fundamental field is connected to the anomalous dimensions of the high spin bilinear operators. The dimensions of these operators can be determined looking to the violations of Bjorken scaling law in deep inelastic electron-proton scattering. The structure function at field ω near to one has a power dependence from q^2, the exponent being the anomalous dimension of the "parton" field. (auth)

3841 (LNF-73/2) DEEP INELASTIC SCATTERING IN A FIELD THEORY WITH COMPUTABLE LARGE-MOMENTA BEHAVIOUR. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 22 Jan 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

It is proved that in a theory characterized by a $g\phi^4$ interaction with a negative coupling constant the deep inelastic structure functions can be directly computed in the Bjorken limit. As a simple

application the structure function $F_2(\omega)$ for deep inelastic scattering is computed at the first order in the coupling constant. (LBS)

3842 HIGH ENERGY CONTRIBUTIONS TO DISPERSION INTEGRALS, ISOTENSOR ELECTROMAGNETIC CURRENT, AND DATA ON PHOTOPRODUCTION OF $\pi^{\pm}$ MESONS FROM THE THRESHOLD UP TO 450 MeV. Aznauryan, I. G.; Zaslavskii, A. N. (Erevan Inst. of Physics). Yadern. Fiz.; 17: No. 2, 374-382(Feb 1973). (In Russian).

A disagreement between dispersion relations and experiment on $\gamma n \rightleftharpoons p\pi^-$ reaction, noted in a number of papers, is removed, if high energy contributions to dispersion integrals are taken into account. Experimental data on differential cross sections for photoproduction of $\pi^{\pm}$ mesons from the threshold up to 450 MeV were described in the dispersion approach. Some disagreement still remains at $E_\gamma = 350$ MeV, $\theta = 90°$, it may be related to the existence of isotensor electromagnetic current. An estimation for the value of isotensor electromagnetic current was obtained. (auth)

3843 INVESTIGATION OF $\gamma\gamma \rightarrow K\bar{K}$ AND $\gamma\gamma \rightarrow \gamma\gamma$ REACTIONS WITH DISPERSION RELATION METHOD. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 2, 368-373(Feb 1973). (In Russian).

The $\gamma\gamma \rightarrow K\bar{K}$ process with account for two-pion intermediate state was studied with the dispersion method. The cross sections for s- and d-waves of the process and cross section for the colliding beam interaction $ee \rightarrow eeK\bar{K}$ were obtained. The contribution of the intermediate $K\bar{K}$-state to $\gamma\gamma \rightarrow \gamma\gamma$ reaction was calculated. (auth)

3844 AMPLITUDE OF COMPTON SCATTERING ON ELECTRONS WITH ACCOUNT FOR RADIATIVE CORRECTIONS. Frolov, G. V. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 2, 355-359(Feb 1973). (In Russian).

An expression for the amplitude of Compton scattering on electrons was obtained in the perturbation theory in e^4 order. This expression was used to calculate the polarization coefficient, which describes the transformation of photon linear polarization into a circular one as a result of scattering. (auth)

3845 DIFFERENTIAL CROSS SECTIONS FOR PAIR PRODUCTION BY PHOTONS ON ELECTRONS. Jarp, S.; Mork, K. J. Ark. Fys. Seminar Trondheim; No. 7, 1-35(1973).

The cross section for pair production by unpolarized photons on free, unpolarized electrons is differential in four nontrivial variables. This cross section is integrated numerically over two or three of the variables, and various energy spectra and angular distributions are obtained. The calculations are restricted to low proton energies, below 5 MeV, where effects of recoil and exchange are important and may be observed. (auth)

3846 KAON PHOTOPRODUCTION. Levy, N.; Majerotto, W.; Read, B. J. (Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Phys.; B55: No. 2, 493-512(1973).

A simple Regge model for high-energy K^+ photoproduction is constructed from kaon and exchange degenerate $K^*(892) - K^{**}(1420)$ trajectories, together with absorption of the low partial waves. Use of SU(3) symmetry and vector-meson-dominance results leaves little freedom in choice of parameters. The model requires the Λ recoil polarization asymmetry to be negative in accordance with recent measurement. The main purpose however is to prepare for an attempt, by extrapolation of the photoproduction model to lower energies and spacelike photon four-momenta, to predict cross sections for K^+ electroproduction. (auth)

3847 DIFFRACTION-DISSOCIATION MODEL FOR HIGH-ENERGY ELECTROPRODUCTION. Kramer, G. (Univ., Hamburg); Quinn, H. R. Nucl. Phys.; B55: No. 1, 222-252(1973).

A model is constructed for two-pion electroproduction in the ρ-resonance region. The production proceeds by diffraction dissociation of the virtual photon into a pion pair which interacts strongly in the p-wave state. The model is compared with recent experimental data from Cornell, DESY and SLAC. (auth)

3848 $SU(6)_W$ ON THE LIGHT CONE. De Alwis, S. P. (CERN, Geneva). Nucl. Phys.; B55: No. 2, 427-435(1973).

Using a transformation recently introduced by Melosh, the consequences of $SU(6)_W$ for the electro- and neutrino-production structure functions in the deep-inelastic region are investigated. (auth)

3849 INCLUSIVE CURRENT-INDUCED REACTIONS AND LIGHT-CONE SINGULARITIES. Fritzsch, H. (Max-Planck Inst. for Physics and Astrophysics, Munich); Minkowski, P. Nucl. Phys.; B55: No. 2, 363-396(1973).

Inclusive reactions of the type current + t → p + anything are analyzed, where t denotes either the vacuum or a hadronic target and p a produced hadron state. Conditions in momentum space are derived which enforce the scaling behavior due to a canonical leading light-cone singularity structure. The multiplicity for the production of p off a hadron target grow less fast than the cm energy. The problem of continuation of deep-inelastic scattering amplitudes to the annihilation channel is investigated. Finally it is outlined how hadronic scaling is obtained in the limit of finite current mass. (auth)

3850 PHOTON INITIATED REACTIONS IN THE RESONANCE REGION. Collins, P. V.; Kowalski, H.; Roemer, H.; Rubinstein, H. R. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett., 44B: No. 2, 183-187(16 Apr 1973).

A consistent picture of two body photon initiated reactions is achieved by implementing a resonance model in the s-channel compatible with duality and gauge invariance. Large real parts generated by contact terms to achieve gauge invariance appear in a well defined pattern. Their size explains hitherto puzzling reactions like $\gamma N \rightarrow \rho N$, $\gamma N \rightarrow \rho\Delta$ and $\gamma N \rightarrow \omega\Delta$, near their thresholds. (auth)

3851 REDUCIBLE SCALE INVARIANCE AT SHORT DISTANCES. Ferrara, S. (CNEN, Rome). Phys. Lett.; 44B: No. 2, 188-190(16 Apr 1973).

It is proven that, using reducible scale invariance at short distances, conformal symmetry implies canonical (Bjorken) scaling, provided diagonal dimensions of dilatation multiplets occurring in the operator product expansion of two electromagnetic currents have the canonical value $l_n = 2 + n$. If the electromagnetic current itself belongs to such multiplets then the hadron production cross section in e^+e^- annihilation falls off faster than $1/s$ at asymptotic energy. (auth)

3852 FIXED-MASS RULES IN A NON-PERTURBATIVE PARTON-MODEL FRAMEWORK. Hughes, R. P.; Osborn, H. (Cambridge Univ., Eng.). Nucl. Phys., B; B54: No. 2, 603-643 (1973).

The formulation of the parton model due to Landshoff and Polkinghorne is used to discuss the various fixed-mass sum rules that can be derived for the structure functions measurable in inelastic electroproduction, including those dependent on the target spin and also allowing for an extension to the non-Abelian case of isovector currents. The model is re-expressed in terms of light-cone variables which achieves some simplification and gives some new results, in particular concerning the leading terms of the longitudinal structure function in the scaling limit for spin-$\frac{1}{2}$ theories. Careful attention is paid to verifying the consistency of the results with current conservation, which is achieved by embedding the model in simple field theories so as to introduce the necessary dynamics. Those sum rules which appear to diverge are shown to be made finite by becoming statements concerning the residue of fixed J-plane poles, for which an analysis is given. (auth)

3853 LOW-t THEOREMS FOR THE INCLUSIVE PROCESS $e^-p \rightarrow e^-\pi$ + ANYTHING AND MINIMAL GAUGE-INVARIANT EXTENSION OF ONE-PION EXCHANGE. Muetter, K. H.; Rothe, H. J.; Stamatescu, I. O. (Univ., Heidelberg). Nucl. Phys.; B55: No. 1, 285-300(1973).

Consequences of pion exchange and gauge invariance for the inclusive reaction $\gamma_V + p \rightarrow \pi$ + anything are discussed. A model is presented for a minimal gauge-invariant extension of pion exchange. Comparison of the model with the existing data on the electroproduction process $e^- + p \rightarrow e^- + \pi^+$ + anything shows good agreement. (auth)

3854 LOW-ENERGY e^4 COMPTON SCATTERING OF SPIN-$\frac{1}{2}$ TARGETS WITHOUT C, P, AND T INVARIANCES. Lin, K. Y.; Kung, C. Y. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Phys.; B54: No. 2, 598-602(1973).

The low-energy e^4 Compton scattering on spin-$\frac{1}{2}$ targets was studied without assuming C, P and T invariances. It is shown that the scattering amplitude has a term $\omega^3 \ln \omega$ (ω is the energy of incident photon in the lab frame), whose coefficient is determined entirely by the charge, mass, magnetic dipole moment, and electric dipole moment of the target. To derive the result, the second-order (in ω) terms of the e^2 Compton scattering amplitudes were calculated. When the electric dipole moment (whose existence violates P and T but conserves PT) is set to zero, the result reduces to that obtained before by Lin assuming C, P and T invariances. (auth)

3855 INELASTIC LEPTON (ANTI-) LEPTON SCATTERING AND THE TWO-PHOTON EXCHANGE APPROXIMATION. Bonneau, G.; Gourdin, M.; Martin, F. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). Nucl. Phys.; B54: No. 2, 573-597(1973).

A general covariant formalism is presented for the inclusive reactions e + e → e + e + anything in the two-photon exchange ap-

proximation. The differential cross section $d\sigma/dW^2$ for the production of a state of effective mass W has been computed in the high-energy limit. A comparison with previous works is made. (auth)

3856 VMD VERSUS PCAC IN $\pi^0 \rightarrow \gamma\gamma$. Preparata, G. Univ., Rome). Phys. Lett.; 44B: No. 2, 165-168(16 Apr 1973).
A conflict between strong PCAC and VMD is pointed out in the decay $\pi^0 \rightarrow \gamma\gamma$. A solution of the problem is presented in the weak PCAC framework. (auth)

3857 DISPERSION-THEORETIC CALCULATION OF THE LEPTON MAGNETIC MOMENT AND FORM FACTORS IN THE GAUGE THEORY OF WEAK INTERACTIONS. Aydin, Z. Z.; Baran, S. A.; Barut, A. O. (International Center for Theoretical Physics, Trieste, Italy). Nucl. Phys.; B55: No. 2, 601-611(1973).
The form factors and the magnetic moment of leptons were evaluated, by dispersion-theoretic techniques, taking into account the new particles introduced in the gauge theory of weak interactions. In these calculations all particles are on the mass shell, and only particles contributing to the unitarity condition need to be considered. The calculations are unambiguous and there is no problem of choice of the loop variable. The relation of the gauge and the corresponding additional particles in the unitarity is discussed. (auth)

3858 SUM RULES FROM BOUNDARY DISPERSION RELATIONS. Hite, G. E. (Univ., Kaiserslautern, Ger.); Jacob, R. J. Nucl. Phys.; B55: No. 2, 587-600(1973).
Sum rules for inelastic reactions are derived from boundary dispersion relations. If sufficient data or a model is available for the amplitude in the direct channel, then these sum rules provide a means of studying the dynamics in the cross channel. The convergence of these sum rules is investigated, assuming they can be saturated with narrow-width resonances, and rough estimates of the coupling constants of cross-channel exchanges for the photoproduction of pseudoscalar mesons are obtained. (auth)

3859 TWO-PHOTON PROCESSES IN THE PARTON MODEL. Walsh, T. F. (Univ., Hamburg); Zerwas, P. Phys. Lett.; 44B: No. 2, 195-198(16 Apr 1973).
Some two-photon processes in colliding e^+e^- beam reactions are studied with the aim of testing the parton model. The parton contributions should dominate in certain well defined kinematical limits, and provide an essential difference between photonic and hadronic processes. (auth)

3860 LIFETIME OF F MESON. DeCelles, P. C.; Montufar, C. (Univ. of Notre Dame, IN). Nucl. Phys.; B54: No. 2, 469-476(1973).
The differential and total cross sections for the photoproduction of the f meson are calculated in terms of the width $f \rightarrow \gamma\gamma$. (auth)

3861 KAON ELECTROPRODUCTION. Levy, N.; Majerotto, W.; Read, B. J. (Deutsches Elektronen-Synchrotron, Hamburg). Nucl. Phys.; B55: No. 2, 513-523(1973).
The simple Regge absorption model used previously for high-energy charged kaon photoproduction is here directly extended to electroproduction, thus providing a framework for theoretical discussion and interpretation of future experimental efforts. (auth)

3862 CONSTRUCTION OF $\pi^\pm$ PHOTOPRODUCTION AMPLITUDES AT HIGH ENERGY FROM DISPERSION RELATIONS AND LOCAL DUALITY. Hontebeyrie, M.; Procureur, J.; Salin, P. (Univ., Bordeaux). Nucl. Phys.; B55: No. 1, 83-105(1973).
The charged-pion photoproduction amplitudes were investigated at all energies. It is first shown that low-energy s-channel helicity amplitudes exhibit, in most cases, a Bessel-function structure of zeroes. At high energy the imaginary parts of helicity amplitudes are therefore parametrized according to the Harari model, and the real parts are computed using fixed-t dispersion relations as proposed recently. Such an evaluation of scattering amplitudes presents some very nice properties. In particular, it allows one to understand from duality arguments how the Born contribution may survive with full strength in the forward direction but not at large t-values. Furthermore FESR are identically satisfied by the model. (auth)

3863 OPTIMAL BOUNDS FOR THE PION FORM FACTOR FROM ANALYTICITY AND EXPERIMENTAL DATA. Raszillier, I. (Inst. of Physics, Bucharest); Schmidt, W. Nucl. Phys.; B55: No. 1, 106-124(1973).
Optimal bounds for the pion electromagnetic form factor F(t) below threshold and on the pion mean-square charge radius $\langle r_\pi^2 \rangle = 6F'(0)$ are derived. Use is made of analyticity arguments and of experimental data on F(t) from $e^+e^- \rightarrow \pi^+\pi^-$ as well as $e^-p \rightarrow e^-n\pi^+$. The method accounts in an approximate way for the statistical errors of the experimental information. Numerical results for F(t) are calculated for the CEA as well as the DESY electroproduction data. (auth)

3864 CURRENT-ALGEBRA CALCULATION OF LOW-ENERGY PION ELECTRO- AND PHOTOPRODUCTION FOR PHYSICAL PIONS. Radutskii, G. M.; Serdyutskii, V. A. (Inst. for Nuclear Physics, Tomsk, USSR). Nucl. Phys.; B54: No. 1, 302-316(1973).
A hard-pion current-algebra model is employed to derive expressions for the pion electro- and photoproduction amplitudes. The low-energy predictions for the multipole amplitudes and differential cross sections of photoproduction are analyzed and compared with the experimental data. (auth)

3865 CORRECTION OF COINCIDENCE ELECTRON-SCATTERING CROSS SECTIONS FOR RADIATIVE EFFECTS. Dickinson, B. (Univ. of Manchester, Eng.). Nucl. Phys., B54: No. 1, 285-301(1973).
The correction of inelastic electron-scattering cross sections for the effects of radiation is considered for experiments in which one of the final-state hadrons is detected in coincidence with the scattered electron. The results are expressed in terms of the missing mass of the unobserved particles. The accuracy of some commonly used approximations is investigated in the case of the $ep \rightarrow ep\pi^0$ reaction in the region of the $\Delta(1236)$ resonance. (auth)

3866 PRODUCTION OF INTERMEDIATE BOSONS $W_1^\pm$ AND $W_0^\pm$ IN COLLIDING BEAMS. Pyzh, V. M. (Kharkov State Univ.). Ukr. Fiz.,Zh. (Russ. Ed.); 18: No. 2, 317-318(Feb 1973). (In Russian).
The cross section of one of the simplest possible reactions of formation of hypothetical intermediate W bosons was calculated. Within the realm of energies which do not exceed the unitary limit, the cross section increased linearly with the energy. (tr-auth)

3867 MINIMAL GAUGE-INVARIANT EXTENSION OF PION EXCHANGE IN THE INCLUSIVE REACTIONS $\gamma p \rightarrow \pi^\pm$ + ANYTHING. Giesecke, J. (Univ., Heidelberg); Rothe, H. J.; Muetter, K. H. Nuovo Cim., 14A: No. 3, 605-612(1 Apr 1973).
It is found that a minimal gauge-invariant extension of the pion-exchange contribution to the inclusive reactions $\gamma p \rightarrow \pi^\pm$ + anything leads to an expression for the difference $d\sigma_{||} - d\sigma_\perp$ of the inclusive cross sections, with photons polarized parallel and perpendicular to the reaction plane, which is determined by the total πp cross section. A direct comparison of the model with experimental data at small momentum transfers is possible in the missing-mass region corresponding to Δ^{++} production. A further comparison of our prediction for $d\sigma_{||} - d\sigma_\perp$ is made with existing data for the unpolarized inclusive cross sections. (auth)

3868 PION ELECTROPRODUCTION AT THRESHOLD. Benfatto, G.; Nicolo, F.; Rossi, G. C. (Univ., Rome). Nuovo Cim., 14A: No. 3, 425-444(1 Apr 1973).
A method is discussed to calculate the axial nucleon form factor g_A and the electromagnetic pion form factor F_π from electroproduction data at threshold. The theoretical ingredients are gauge invariance, low-energy theorems and fixed-t dispersion relations. The errors involved in the unavoidable approximations are also discussed. (auth)

3869 CASCADE CURVES AND FLUCTUATIONS OF MEAN CHARACTERISTICS FOR DEVELOPMENT OF SHOWERS PRODUCED BY γ-QUANTA WITH THE ENERGY 1600 MeV IN LIQUID XENON. Slovinskii, B.; Strugal'skii, Z.; Khubert, V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 4, 734-738(Oct 1972). (In Russian).
The process of electron–photon shower development produced in liquid xenon by γ-quanta of 1600 MeV energy is being studied. The results are presented in the form, suitable for working out methods for determining γ-quantum energy by the showers, produced by them. In particular, some information on fluctuations of the total range of the observed shower electrons, that corresponds to definite depths of shower electrons, that corresponds to definite depths of shower development is presented. (auth)

3870 PROBLEM OF CAUSALITY VIOLATION AT MOTION OF HIGH SPIN PARTICLES IN EXTERNAL FIELD. Khriplovich, I. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Yadern. Fiz.; 16: No. 4, 823-834(Oct 1972). (In Russian).
A quasiclassical description of the influence of anomalous magnetic and quadrupole particle moments on its motion in the external electromagnetic field is constructed. For a vector particle both anomalous interactions may lead to velocities exceeding the speed of light, if one does not take into account the

electromagnetic radiation. Existence of self-consistent description of interaction with external electromagnetic field for a charged particle with the spin 2 is marked out. (auth)

3871 VIRTUAL $\gamma\gamma$-SCATTERING AND NEW TYPE OF SCALING. Chernyak, V. L. (Novosibirsk State Univ., USSR). Yadern. Fiz.; 16: No. 4, 778-792(Oct 1972). (In Russian).

The amplitude asymptotic of virtual $\gamma\gamma$-scattering for the range of photon large masses has been considered. The new type of scaling behavior is predicted. It is shown, that Regge-trajectories and two-reggeon cuts give a contribution to the corresponding scaling functions. The behavior at small distances in φ^3-theory has been studied. The formulas for expansion of local and bilocal products of the operators in the neighborhood of the light cone are proposed. (auth)

3872 C-EVEN RESONANCE PRODUCTION IN ee COLLIDING BEAMS. Account for Experiment Geometry in Two-Particle Decays. Slivkov, A. K.; Shvartsman, Sh. M. (Novosibirsk State Univ., USSR). Yadern. Fiz.; 16: No. 4, 802-808(Oct 1972). (In Russian).

The cross sections for two-photon production of C-even resonances in ee $\rightarrow$ ee + R processes have been calculated with account for some peculiarities of the experiment. It is shown, that the measured cross section comprises a very small fraction of the total one, if there are detected only the resonance decay products, emitted at large angles. (auth)

3873 e^+e^--PAIR PRODUCTION IN VARIABLE ELECTRIC FIELD. Popov, V. S.; Marinov, M. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 4, 809-822(Oct 1972). (In Russian).

The calculation of probability w of production of fermion pairs in vacuum under the influence of variable electric field E(t) comes to a solution of the problem on parametric excitation of quantum oscillator. The cases, when external field E(t) preserves constant direction in space or is situated in a definite plane, are treated in detail. By the "imaginary time" method a closed formula was obtained for probability w in the case of the field with elliptical polarization. (auth)

Weak

3874 (COO-2271-2) TESTS FOR A WEAK NEUTRAL CURRENT IN $l^{\pm} + N \rightarrow l^{\pm}$ + ANYTHING AT HIGH ENERGY. Derman, E. (Columbia Univ., New York. Dept. of Physics). 1972. 59p. Dep. NTIS $5.00.

Tests for a weak neutral current in high energy inclusive $l^{\pm} - N$ scattering are discussed, where l is a charged lepton and N a nucleon. If the polarization of the incoming lepton or the target nucleon can be varied, or the outgoing lepton's polarization observed, an unambiguous measurable consequence of such a current is parity violation. Some general expressions for parity violating correlations are derived, and their magnitude in particular models is calculated. Further consequences of such a current are (i) a difference between $l^- - N$ and $l^+ - N$ cross sections and (ii) a deviation of the l^--N cross section from the form implied by one photon exchange only. Tests for these effects are similarly examined, but an accurate knowledge of higher order electromagnetic contributions to them is necessary before such tests can be implemented. (auth)

3875 (IFVE-SPK-72-35) PRODUCTION OF CHARGED LEPTONIC PAIRS BY HIGH-ENERGY NEUTRINOS ON NUCLEONS AND NUCLEI IN THE THEORY WITH INTERMEDIATE W-BOSON. Makeev, V. V.; Nevskii, P. L.; Nikitin, Yu. P.; Rozhnov, G. V.; Sokolov, A. A. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 32p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

The total, angular $d\sigma/d\Omega$ and double differential $d^2\sigma/dE\,\partial\Omega$ cross sections of μ^- and l^+ leptons in $\nu_\mu + Z \rightarrow \mu^- + W^+ + Z$, $W^+ \rightarrow l^+ + \nu_l$ (Z - p, n or nucleus) and $\nu_\mu + p \rightarrow \mu^- + W^+ +$ hadrons are calculated. In these calculations integration is carried out over neutrino spectrum of the IHEP accelerator, expected in the location of the chamber SKAT. The calculations are carried out for W-boson mass (m = 3, 4, 5 GeV) and for the total magnetic moment of W-boson (g = 0, 1, 2) at various targets. Nucleon motion in the nucleus is taken into account. (auth)

3876 DECAY OF A HEAVY NEUTRAL LEPTON. Akulov, V. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 10, 1743-1745(Oct 1972). (In Russian).

The production of a neutral heavy lepton L^0 may be expected both in experiments with high energy neutrinos and in μ-capture process according to the pattern $L^0 \rightarrow \pi^+\mu^-$. The probability of heavy lepton decay in a system at rest was investigated; the expected lifetime of a lepton of mass $M_L \approx 420$ MeV was $\gamma_{L_0} \approx 2 \times 10^{-10}$ sec. (KSW)

3877 SECOND-CLASS CURRENTS IN WEAK INTERACTIONS. Lobov, G. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 881-884(Apr 1972). (In Russian).

The existence of second-order currents in weak interactions may be due either to the possible isotopic noninvariance of strong interactions, renormalized seeding weak currents, or the G-noninvariance of these weak currents. On the basis of data reported by D. H. Wilkinson, tensor constants of weak second-order, axial-vector currents were derived. The values obtained agreed with literature data based on capture of μ^- mesons in ^{12}C. Because of the large transformed pulse, the contribution of the second-order currents is considerable also with respect to the decay probability of $\Sigma^{\pm}$ hyperons. However, the large experimental uncertainty makes it as yet impossible to obtain the tensor constants of the second-order current. (TTT)

3878 THREE-TRIPLET REALIZATIONS OF GAUGE MODELS AND DEEP-INELASTIC SCATTERING. Love, A. (Univ. of Sussex, Brighton, Eng.); Nanopoulos, D. V.; Ross, G. G. Nucl. Phys.; B55: No. 1, 33-44(1973).

The predictions for very-high-energy inelastic neutrino scattering of three-triplet realizations of the weak-interaction gauge theories based on the groups O(3) and SU(2) $\times$ U(1) are investigated. (auth)

3879 COMPUTATION OF ADLER's β SUM RULE. Bijtebier, J. (Univ. Libre, Brussels). Nucl. Phys.; B55: No. 1, 322-332 (1973).

An attempt is made to check Adler's β sum rule for $q^2 = \mu^2$. The integral of β can be divided into two parts: a first part which, if $q^2 = \mu^2$, involves only an integral of the experimental πN cross section, and a second one which is a priori of order μ^2 compared to the first. This second term can be approximated by an explicit calculation of the $N^*_{\frac{1}{2}\frac{3}{2}}$ contribution in the framework of Adler's model for the $\nu N \rightarrow \mu N^*$ reactions. The sum rule is not too well balanced and different hypotheses are presented to explain the defect. (auth)

3880 ELASTIC NEUTRINO-ELECTRON SCATTERING AND NEUTRAL LEPTON CURRENTS. Kerimov, B. K.; Bogdanov, Yu. P. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2607-2613(Dec 1972). (In Russian).

The differential and total cross sections of the elastic neutrino-electron scattering $\nu_e + e^- \rightarrow \nu_e + e^-$ were calculated in first-order perturbation theory for weak mixed (V,A) interactions. Allowance was made simultaneously for charged and neutral lepton flux interactions. (3 figures) (KSW)

3881 POSITIVITY INEQUALITIES FOR SPIN-DEPENDENT LEPTON-HADRON SCATTERING FROM THE LIGHT-CONE ALGEBRA OF QUARK CURRENTS. Gnaedig, P.; Niedermayer, F. (Roland Eoetvoes Univ., Budapest). Nucl. Phys.; B55: No. 2, 612-620(1973).

Positivity inequalities restricting spin-dependent electron-nucleon scattering and neutrino-nucleon scattering have been found. Interesting bounds for the difference of the spin asymmetry on proton and neutron have been found from inequalities derived from the light-cone algebra of quark currents. The same results have been derived from the quark-parton model. (auth)

3882 INTERMEDIATE WEAK BOSON AND WEAK INTERACTIONS AT HIGH ENERGY. Ninomiya, M.; Nitto, H.; Watanabe, K. (Nagoya Univ., Japan). Nucl. Phys.; B55: No. 2, 524-540(1973).

The high-energy pure-leptonic weak interaction is investigated based on the assumption of the existence of a charged vector boson which mediates the weak processes. With the aid of the fixed-t dispersion relation the following relation is obtained: The weak boson mass m_W should satisfy $m_W \gtrsim G^{-\frac{1}{2}}$, with G the Fermi coupling constant, if the asymptotic value of the cross section becomes of the order of the strong interaction in the energy region observable in cosmic rays, etc. The scattering processes $e + \nu \rightarrow e + \nu$ and $e + \bar{\nu} \rightarrow e + \bar{\nu}$ are examined by the aid of the N/D method. For a large vector-boson mass $m_W \gtrsim 100$ GeV, an S-wave resonance should exist for the process $e + \nu \rightarrow e + \nu$ while for $e + \bar{\nu} \rightarrow e + \bar{\nu}$ there should exist a P-wave resonance which corresponds to the intermediate weak boson. The neutral current is then estimated. It is shown that the neutral current produced as a higher-order effect is not inconsistent with the present experiments on the pure-leptonic weak interaction if $m_W \lesssim 1$ TeV. (auth)

3883 PSEUDO-CABIBBO STRUCTURE IN A GAUGE THEORY OF WEAK INTERACTIONS AND ELECTROMAGNETISM. Georgi, H.; Glashov, S. L. (Harvard Univ., Cambridge, Ma.). Phys. Lett.; 44B: No. 2, 191-194(16 Apr 1973).

An alternative to the Cabibbo theory is presented in the context of a renormalizable gauge model of weak and electromagnetic interactions. The strangeness-changing hadronic weak current is assumed to be V + A. (auth)

3884 INTERACTION INTERPRETATION OF SPECIAL RELATIVITY THEORY. Part I. Schlegel, R. (Michigan State Univ., East Lansing). Found. Phys.; 3: No. 2, 169-184(Jun 1973).

In the established space-time coordinate-transformation (STCT) interpretation of special relativity theory, relativistic changes are consequent upon the Lorentz transformation of coordinate clocks and rods between relatively moving systems. In the proposed alternative interpretation, relativistic changes occur only in association with physical interactions, and are direct alterations in the variables of the observed system. Since space-time and momentum-energy are conjugate four-vectors, transformation of a space or time variable of a system is to be expected only if there is a concomitant transformation of the corresponding momentum or energy variable. The Lorentz invariance of the scalar entropy function S supports the interaction interpretation; time $t = f(S)$ of a macroscopic, entropy clock should give a Lorentz-invariant time measure, and an illustrative entropy clock is discussed. Noninteracting physical processes may be called Clausius processes, in contrast to Lorentz processes for which there is interaction and associated Lorentz transformation. Changes of energy and frequency, with $E = h\nu$, are instances of the parallel relativistic transformations. Likewise, the variation with velocity in decay time of mesons follows directly from the relativistic energy transformation of decay products; this relation is shown for muons by a simple calculation with β-decay theory. (auth)

3885 νe-SCATTERING, ELECTROMAGNETIC PROPERTIES OF NEUTRINO AND WEAK INTERACTION VARIANTS. Rekalo, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 2, 213-217(Feb 1973). (In Russian).

On the basis of experimental data the upper limits to the electromagnetic properties of the electron and muon neutrino and the limits for weak ($\bar{e}\nu$) ($\bar{\nu}e$)-interaction constants are obtained. The possibility to determine the sign of electromagnetic characteristics of neutrino is discussed. (auth)

3886 BILOCAL ALGEBRA AND THE PARTON MODEL IN $\nu_\mu + p \rightarrow \mu^- + e^+ + e^-$ + HADRONS. Troost, W.; Verwaest, J. (Univ., Louvain, Belgium). Nucl. Phys.; B54: No. 1, 317-331 (1973).

The cross section for $\nu_\mu + p \rightarrow \mu^- + e^+ + e^-$ + hadrons in the deep-inelastic region was calculated using the Fritzsch and Gell-Mann light-cone algebra. The connection with the parton model is made. (auth)

3887 ASYMMETRIES IN SEMI-LEPTONIC HYPERON DECAY. Kaufman, C.; Stremnitzer, H. (Univ., Vienna). Nucl. Phys.; B54: No. 1, 217-226(1973).

The parameters of semi-leptonic baryon decay are calculated to lowest order in the weak coupling constant. The particular parameters calculated are the baryon, lepton, and neutrino asymmetries in the decay of an initially polarized baryon, and the lepton-neutrino correlation coefficient, which is measured in unpolarized samples. (LBS)

3888 WEAK INTERACTIONS. Primakoff, H. (Univ. of Pennsylvania, Philadelphia). pp 269-414 of Lectures on Elementary Particles and Quantum Field Theory. Vol. II. Deser, S. (ed.). Cambridge, MA; Massachusetts Inst. of Tech. Press (1970).

Some aspects of weak interactions are discussed, with primary attention given to purely leptonic processes and to some extent attention is given to the semileptonic weak processes where the complications arising from the presumed composite structure of the hadrons are either entirely absent or can be essentially assumed in a small number of form factors. The experimental evidence for lepton conservation and the implications of a possible lepton conservation are discussed. A treatment of first-order and second-order weak collision processes of neutrinos with electrons and with nucleons is presented, and a general treatment of second-order weak processes is outlined. Abnormalities in the weak currents are also discussed. (LBS)

3889 SLOPE OF THE SCALAR K_{l3} DECAY FORM FACTOR. Renner, B.; Wambach, U. M. (CERN, Geneva). Nucl. Phys.; B54: No. 1, 1-5(1973).

A mechanism is discussed, based on exact threshold theorems in the limit of SU(2) × SU(2) symmetry, which can be used to estimate a certain suppression of the scalar K_{l3} decay form factor at low momentum transfers, while maintaining the validity of the Callan-Treiman relation. (auth)

Strong (General)

3890 (COO-2271-3) TWO PHOTON PRODUCTION OF LEPTON PAIRS IN HADRON-HADRON COLLISIONS. Soni, A. (Columbia Univ., New York). [nd]. 30p. Dep. NTIS $3.50.

The cross section for the two photon exchange production of lepton pairs in hadron-hadron collisions is evaluated here up to the leading order in logS for $S \rightarrow \infty$ holding either M^2 or M^2/S fixed. To take into account elastic as well as inelastic emission of photons from hadrons the general spectrum of equivalent photons is derived in terms of the structure functions of the hadrons and this spectrum is then used for evaluating the leading logS terms in the two photon cross section. The lepton mass dependence and the angular distribution of the two photon process are also discussed. (auth)

3891 (COO-2271-8) RADIATIVE CORRECTIONS TO $P + P \rightarrow l^+ + l^-$ + "ANYTHING" AND APPLICATION TO MUON-ELECTRON SYMMETRY. Soni, A. (Columbia Univ., New York). 1972. 12p. Dep. NTIS $3.00.

Radiative corrections, to order α^3, are carried out to the lepton lines in the process $P + P \rightarrow l^+ + l^-$ + "anything." Expressions are derived which relate the radiative corrections, due to the emission of soft photons, and of hard photons from the lepton lines, to the observed cross section for production of electron or muon pairs. These expressions are used to predict the difference, based purely on electromagnetic interactions, between the cross sections for production of electron and muon pairs. As a specific example, computations are done using the BNL data for production of lepton pairs in hadron-hadron collisions. (auth)

3892 PRODUCTION OF BARYON-ANTIBARYON PAIRS AND QUARKS IN HADRON COLLISIONS. Pyzh, V. M. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 10, 1600-1607(Oct 1972). (In Russian).

In terms of a modified peripheral model expressions are obtained for differential and total cross sections of the high energy reactions $P + N \rightarrow N + \bar{B}_1 + B_2$ (P is a pseudoscalar meson, N-nucleon, B-baryon). The free parameter of the model was determined by comparison with experimental data from the reaction $\pi^- + p \rightarrow p + p + n$. Asymptotic values are calculated for different reactions of the type $P + p \rightarrow p + \bar{B}_1 + B_2$, using the ratios of SU(3)-symmetry between coupling constants. The model is used to calculate energy dependence of the total cross sections of quark production in πN- and NN-collisions. The results of the calculations are compared with predictions of other theoretical models and with the data of experiments carried out on accelerators. Analysis of the experimental data on the basis of the conducted calculations makes it possible to state that the quark mass with a charge of 2/3e is greater than 4.2 GeV/c^2 and the quark mass with a charge of 1/3e is greater than 4.5 GeV/c^2. (auth)

3893 DUAL POMERON AND DIFFRACTION DISSOCIATION. Morel, B.; Quiros, M. (Univ., Geneva). Nucl. Phys.; B55: No. 1, 226-284(1973).

The N-reggeon M-loop amplitude is computed in the so-called conventional dual resonance model. This formula is specialized to the lowest-order dual pomeron diagram. Diffractive and elastic helicity amplitudes are analysed and properties of helicity conservation in the direct and crossed channels are studied. It is found that diffractive production of spin-even resonances dominates asymptotically the diffractive production of spin-odd resonances. (auth)

3894 ESTIMATE OF THE DIMENSION OF HADRONIC MATTER. Nielsen, H. B. (Univ. of Copenhagen). Nucl. Phys.; B54: No. 2, 477-482(1973).

Within a rather simple and reasonable model of hadronic matter as a d-dimensional substance with harmonic forces in the infinite-momentum frame it is crudely estimated that the average squared transverse momentum of the particles having longitudinal momentum equal to x times that of the initial-state hadron of which they should be considered fragments behaves like $\langle p_\perp^2 \rangle \propto x^{1-1/d}$. If this estimate is combined with the experimental fact that the transverse-momentum average is not very dependent on x, i.e. that the seagull effect is weak, it follows that $d \approx 1$. (auth)

3895 SU(3) BREAKING AND PARTICLE PRODUCTION. Amann, R. F.; Blackmon, M. L. (Syracuse Univ., N. Y.). Nucl. Phys.; B55: No. 1, 189-194(1973).

The effects upon measured particle-production ratios of the electromagnetic and weak decays of directly-produced particles are discussed. The importance of η production as a source of γ's, and of K_S production as a source of $\pi^{\pm}$'s, is discussed. The f-dominated Pomeranchukon model is explored as a possible source of η and K suppression. The predicted suppressions are however only of order 0.6; thus η and K production are predicted to be important at high energies, and, consequently $\langle n_\gamma \rangle$ is predicted to significantly exceed $\langle n_{\pi^+} \rangle + \langle n_{\pi^-} \rangle$ at high energy. (auth)

3896 QUARK MODEL FOR MULTIPARTICLE AND INCLUSIVE REACTIONS. Anisovich, V. V. (Inst. of High Energy Physics, Serpukhov, USSR); Shekhter, V. M. Nucl. Phys.; B55: No. 2, 455-473(1973).

The relative multiplicity of different hadrons produced in high-energy collisions is found in the framework of the quark model. Apart from the usual hypothesis about the quark structure of hadrons, two extra assumptions are made. Firstly, produced particles are supposed to be mainly the members of the meson 36-plet and baryon (antibaryon) 56-plet. Secondly, production of strange quarks is assumed to be suppressed relative to non-strange quarks roughly by a factor of three, as taken from experiment. In the small-x region the agreement with experimental data is satisfactory. In the fragmentation region it is necessary to take into account the kinematics of the resonant state's decay. The influence of such decay on the x and p_T^2 distributions of hadrons is discussed. (auth)

3897 EXPERIMENTAL CHECK OF THE QUARK-MODEL RELATIONS FOR INCLUSIVE REACTIONS. Anisovich, V. V. (Inst. of High Energy Physics, Serpukhov, USSR); Kobrinskii, M. N.; Likhoded, A. K.; Shekhter, V. M. Nucl. Phys.; B55: No. 2, 474-492(1973).

The quark-model relations for inclusive reactions obtained in the previous paper by two of the authors are compared with existing experimental data. The x and p_T^2 distributions are considered for hadrons produced as a result of fragmentation of an incident meson or nucleon, with the kinematics of the resonance decay being taken into account. The predictions of the quark model are in a reasonable agreement with experiment, both in the shape of spectra and in the absolute magnitude of cross sections. A number of predictions is obtained for cross sections of some inclusive reactions which are not yet measured. (auth)

3898 TRUNCATED STATISTICAL BOOTSTRAP EQUATION. Chiu, C. B. (Univ. of Texas, Austin). AT(41-1)-3992. Nucl. Phys.; B54: No. 1, 170-188(1973).

An extension of the thermodynamic bootstrap model in which the volume parameter depends on the number of subfireballs N is proposed. Based on the conventional three-point resonance coupling, it is suggested as a first approximation that $N \geq 3$ terms should be dropped. One can then describe the many-particle system in terms of two-body interaction dynamics. Three kernels for the bootstrap integral equation are considered, with an analytic solution presented for one of them. Properties of the fireball deduced from the truncated equation are presented. Most properties are insensitive to the kernel used. The observed average pion multiplicity in $\bar{p}p$ annihilation at rest is reproduced with the two-body interaction range $r = 1.22\,\lambda_\pi$. The dependence of the average pion multiplicity on the fireball mass m is given by $\langle n_\pi \rangle \approx 2.0m + 0.62$. This slope agrees with the empirical value found in the Nova model. For a fireball with mass less than 2 GeV/c, the truncated equation predicts that over 50% of the events have successive emission of pions at each step along the decay chain. This provides some justification for the random-walk assumption for Nova decay. The momentum distribution of pions, neglecting the fireball recoil effect, in the small-p region has the form $d\sigma/dp^2 \approx \exp(-p^2/K^2)$ with $K \approx 0.23$ GeV. Finally with the duality coupling scheme, fireballs are associated with exotic states dual to the cross-channel exchange. The weak version of the strong central absorption prescription for two-body scattering is in accord with this scheme. This scheme also explains the presence of the Ericson fluctuations in the non-exotic elastic differential cross sections, but not in the exotic ones. (auth)

3899 CRITICAL QUESTIONS CONCERNING A STATISTICAL APPROACH TO THE HADRON MASS SPECTRUM. Bassetto, A. (CERN, Geneva); Sertorio, L. Nuovo Cim., 14A: No. 3, 548-566(1 Apr 1973).

The problem of the hadron mass spectrum is studied starting from an S-matrix which is explicitly considered as a unitary operator. Making use of the additional property that the connected part T_c is a compact operator, the approximation of T_c by resonances is discussed. The connection with statistics is made by using the Bernstein-Dashen-Ma formalism together with a bootstrap assumption. Although the approach remains open, it allows a critical discussion of subtle issues concerning both the Hagedorn and the dual theories. (auth)

3900 REGGE MODELS AND DUALITY. Jacob, M. (CERN, Geneva). pp 91-267 of Lectures on Elementary Particles and Quantum Field Theory. Vol. II. Deser, S. (ed.). Cambridge, MA; Massachusetts Inst. of Tech. Press (1970).

An attempt is made to describe how duality, first brought into shape as a new idea from a phenomenological approach, has developed into a sufficiently precise formulation as to become a required property of theoretical models and as a guideline for a possible theory of strong interactions. Global duality is first discussed. Other topics deal with linear trajectories, diffraction scattering and exotic states; duality in a semi-local way; duality and unitary symmetry; dual models for meson–meson scattering, dual models for production processes, and dual theory. (LBS)

3901 ELECTROMAGNETIC MECHANISM OF INELASTIC HADRON COLLISION AT HIGH ENERGY. Matinyan, S. G.; Ter Isaakyan, N. L.; Khoze, V. A.; Shakhnazaryan, Yu. G. (Inst. of Physics, Erevan). Yadern. Fiz.; 16: No. 4, 793-801(Oct 1972). (In Russian).

It is shown that at high momentum transfers the cross section of inelastic hadron interaction with two jets production going through one-photon exchange is essential and, probably, significantly dominates over the cross section of analogous strong interaction process. The phenomena connected with electromagnetic mechanism of inelastic hadron collision at high and low momentum transfers are considered in detail. (auth)

3902 ANALYSIS OF DUAL FERMION MODEL. Manida, S. N.; Franke, V. A. (Leningrad State Univ.). Yadern. Fiz.; 16: No. 4, 769-777(Oct 1972). (In Russian).

The properties of two-fermion vertices in dual theory, proposed by Ramond, Neveu, Schwarz and Thorn are being studied. An expression for such a vertex has been obtained for the case of excited fermion states. It is shown, that at fermion mass squared $M^2 = -3/4$ this vertex satisfies Virasoro gauge conditions in mesonic variables, if fermions are in the basic state. (auth)

Strong (Baryon No. = 0)

3903 (FRNC-TH-339) PHENOMENOLOGICAL STUDY OF AMPLITUDES AT ANY ENERGY AND FOR ANY ANGLE UNITARITY, DUALITY, AND ABSORPTION. Lacaze, R. (Paris Univ. (France)). 1972. 134p. (In French). Dep. NTIS (U. S. Sales Only($8.75.

Different aspects of the phenomenology of strong interactions are presented (dominance of resonances, Regge pole exchange, finite energy sum rules, duality, absence of exotic exchange, exchange degeneracy, and absorption). An attempt is made to introduce absorption effects into the duality scheme: a general model for the duality between absorbed resonances and absorbed Regge poles is presented. Concrete models are then applied to π-π scattering, these models demonstrating the possibility of introducing crossing symmetry absorption into the duality. Dual diagrams were used to construct a phenomenological model for the pomeron. (France)

3904 MULTIPERIPHERAL THEORY ON HADRON INTERACTION AT HIGH ENERGIES; $\pi\pi$-INTERACTION. Volkov, E. I.; Dremin, I. M.; Dunaevskii, A. M.; Roizen, I. I.; Chernavskii, D. S. (Lebedev Inst. of Physics, Moscow). Yadern. Fiz.; 17: No. 2, 407-422(Feb 1973). (In Russian).

Properties of elastic and inelastic processes were considered on the basis of the Bethe–Salpeter equation. The kernel of equation is chosen proceeding from phenomenological considerations, and free parameters are defined by main properties of total cross sections. A solution of the equation with the indicated kernel was obtained, and basic properties of elastic scattering (diffraction cone width, parameters P, P′, and ρ-trajectory) were found. They are in good agreement with experimental data. Some characteristic properties of corresponding inelastic processes are discussed. (auth)

3905 A_2-MESON PRODUCTION AT HIGH ENERGIES. Matinyan, S. G.; Shakhnazaryan, Yu. G. (Erevan Inst. of Physics). Yadern. Fiz.; 17: No. 2, 383-387(Feb 1973). (In Russian).

Dependences of angular distribution and asymmetry Σ and P_0 upon transferred momentum squared, and of total cross section upon energy for charged A_2-meson production on nucleons were obtained on the basis of the model with one pion exchange in the t-channel with account of absorption. (auth)

3906 HEAVY ρ MESONS AND PION ELECTROMAGNETIC FORM FACTOR. Shcherbin, Yu. P. (Leningrad State Univ.). Yadern. Fiz.; 17: No. 2, 360-367(Feb 1973). (In Russian).

Dispersion sum rules, which allow one to study the behavior of G(t) argument in asymptotic domain ($t > 1$ GeV^2) were derived on the basis of analyticity of the pion electromagnetic form factor G(t). Applying the available experimental data for description of G(t) one can show, that r.m.s. value for arg G(t) in asymptotic domain does not reveal any considerable deviations from the phase values, which may be expected extrapolating the data on G(t) from ρ-resonance domain into asymptotic one. Rough estimations for contributions to dispersion sum rules of hypothetic heavy ρ-like resonances were made. From these estimations and obtained results on weighted mean value of arg G(t) it follows, that in the in-

terval $\sqrt{t}$ 1 to 1.7 GeV strong ρ-like resonances do not exist. (auth)

3907 $K\bar{K}$ EFFECT IN $\pi\pi$ SCATTERING. Brehm, J. J. (Univ. of Massachusetts, Amherst). Nucl. Phys.; B55: No. 1, 167-188(1973).

The current picture of s-wave isoscalar $\pi\pi$ scattering shows a sharp rise of the phase shift δ_{00} through a resonance just below the $K\bar{K}$ threshold. A model based on coupled $\pi\pi$ and $K\bar{K}$ channels is developed for understanding this phenomenon. The method is one in which four form factors are analyzed: the π to π and K to K matrix elements of two isoscalar sigma commutators derived from $(3,\bar{3}) + (\bar{3},3)$ symmetry breaking. The equations for the system of coupled form factors are obtained from hard-meson current algebra and solved in terms of analytic functions having the $\pi\pi$ and $K\bar{K}$ cuts. Unitarity is invoked to extract the desired $\pi\pi$ phase shift. The dramatic influence of the $K\bar{K}$ channel is apparent in the solution and an excellent fit to the recent data is obtained. An S* resonance is among the results; the resonance pole on the second sheet is found at complex energy $M - \frac{1}{2}i\Gamma = (1006 - 23i)$ MeV. (auth)

3908 ASYMPTOTIC RESTRICTIONS AND $\pi\pi$ SCATTERING LENGTHS IN NON-LINEAR CHIRAL SU(2) × SU(2) DYNAMICS. Vereshchagin, V. V. (Inst. of High Energy Physics, Serpukhov, USSR). Nucl. Phys.; B55: No. 2, 621-636(1973).

The most general effective Lagrangian for $\pi\pi$ scattering, that takes into account the exchange of scalar (0^+), tensor (2^+) and ρ mesons, is constructed within the framework of non-linear chiral SU(2) × SU(2) dynamics. Asymptotic restrictions proposed by Weinberg are imposed on the amplitude of $\pi\pi$ scattering. These restrictions allow one to obtain four independent sum rules containing particle masses, coupling constants and the coefficient A_2 in an expansion of the symmetry-breaking term in a power series of π^2. The use of only the f^0 meson in the obtained sum rules leads to the following values of the $\pi\pi$ scattering lengths, the width of $\epsilon(700) \to 2\pi$ decay, and the parameter A_2: $\alpha_0^0 = 0.92\ m_\pi^{-1}$, $\alpha_0^2 = 0.27\ m_\pi^{-1}$, $\alpha_1^1 = 0.033\ m_\pi^{-3}$, $\Gamma[\epsilon(700) \to 2\pi] = 390$ MeV, $A_2 = +1.6$. It is shown that the inclusion of heavier mesons results in some increase of the $\pi\pi$ scattering lengths and the parameter A_2, but a decrease of the value of $\Gamma(\epsilon \to 2\pi)$. The field-algebra requirements lead to negligible changes in the results. Analysis of the sum rules shows the incompatibility of the asymptotic restrictions with a symmetry breaking which has the transformation properties of the fourth component of a chiral vector. (auth)

3909 PHENOMENOLOGICAL INVESTIGATION OF PION–KAON SCATTERING. Nielsen, H.; Oades, G. C. (Univ. of Aarhus, Denmark). Nucl. Phys.; B55: No. 1, 301-321(1973).

Information is obtained on the I = 0, J = 0 and I = 1, J = 1 $\pi\pi - K\bar{K}$ partial waves via dispersion relations for πK backward scattering and for the $\pi\pi - K\bar{K}$ partial waves. The ρ coupling corresponds to $G_{\rho KK}/G_{\rho\pi\pi} = 1.3 \pm 0.3$ while the ϵ exchange amplitude is very small for $t \lesssim 15\ \mu^2$ and is poorly determined for large t values. The invariant amplitudes below the s-, t- and u-channel thresholds are in good agreement with current algebra. (auth)

3910 INFLUENCE OF NON-ANALYTIC TERMS ON THE GELL-MANN–OKUBO RELATION FOR THE PSEUDOSCALAR MESONS. Cornwell, D. T. (Univ., Karlsruhe, Ger.). Nucl. Phys.; B55: No. 2, 436-444(1973).

Li and Pagels have demonstrated that one can understand the pseudoscalar mesons coming off the chiral limit in an octet-broken fashion. One might therefore hope to be able to attribute the major part of the error in the Gell-Mann–Okubo relation to the next leading contributions to the masses, which are $O(\lambda^2 \ln \lambda)$, where λ is the breaking parameter. In the following the effect that such terms may have is considered in the $(3,\bar{3}) + (\bar{3},3)$, (8,8) and $(6,\bar{6}) + (\bar{6},6)$ models of chiral-symmetry breaking. Of these the (8,8) fares the best. (auth)

3911 QUARK MODEL OF MESONS BASED ON CHIRAL SYMMETRY. Casher, A.; Susskind, L. (Tel-Aviv Univ., Ramat Aviv, Israel). Phys. Lett.; 44B: No. 2, 171-174(16 Apr 1973).

A model of mesons as $q\bar{q}$ pairs is constructed in the infinite momentum frame. The basic symmetry is spontaneously broken chiral $SU_3 \times SU_3$. The rates for the decays $\rho \to 2\pi$, $\sigma \to 2\pi$, $A_1 \to \rho\pi$, $A_1 \to \sigma\pi$, $A_2 \to \eta\pi$, $\pi_N \to \eta\pi$, $D \to \eta\pi$, $f \to 2\pi$ and the coupling constant, $g^2_{\rho\omega\pi}$ are computed. Qualitative agreement is found with the experimental values. The theory is similar to that of Gilman and Harari. (auth)

3912 EFFECTS OF $\pi\pi$-INTERACTION IN INELASTIC πN AND NN COLLISIONS AT HIGH ENERGIES. Kuchin, I. A.; Usik, P. A. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 33-39(1972). (In Russian).

Available experimental data on high energy πN- and NN-collisions may be interpreted as a result of the formation of heavy $\pi\pi$-systems, the average mass of which increases with an increase in energy as $\sqrt{E_1}$. (tr-auth)

3913 $\pi^+\pi^- \to \pi^0\pi^0$ CHARGE EXCHANGE REACTION AND S-MESON. Makarov, M. M.; Nelyubin, V. V. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 16: No. 4, 764-768(Oct 1972). (In Russian).

$\pi^-p \to \pi^0\pi^0n$ and $\pi^+n \to \pi^0\pi^0p$ reactions were considered to obtain the $\pi\pi$-scattering cross section, using the one-meson approximation. The following S-wave resonance parameters were obtained $M_0 = 0.74$ GeV, $\Gamma = 0.5$ GeV. (auth)

Strong (Baryon No. = 1)

3914 (DESY-73/8) DOES $\rho'(1650)$ CONTRIBUTE TO THE NUCLEON FORM FACTOR? Bellandi Filho, J.; Meyer, R. F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Mar 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The vector meson $\rho'(1650)$, observed in recent experiments, is included into a description of nucleon form factors in the vector dominance model. An attempt to fit the form factor data is made and possible modifications of the model are discussed. The result for the ρ'-nucleon coupling constant is compared with a value which is estimated using antiproton-proton annihilation data. (auth)

3915 (IC-73/34) MAGNETIC CHARGES AND STRINGS AS BUILDING BLOCKS OF HADRONS: CONNECTION BETWEEN ELECTROMAGNETIC AND DUAL STRINGS. Barut, A. O. (International Centre for Theoretical Physics, Trieste (Italy)). Apr 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

The infinite multiplets and magnetic charges connections with the spectrum of the dual models, with the underlying string models, and with saturation of current algebras are pointed out. It is shown how one can obtain, starting from a very simple physical model involving magnetic charges, the internal dynamical properties of hadrons, in particular of the proton, such as the elastic and inelastic form factors, mass spectra, and inelastic structure functions. (JFP)

3916 (IFVE-STF-72-55) ANALYSIS OF DISPERSION RELATIONS FOR PION–NUCLEON SCATTERING AT HIGH ENERGIES. Solov'ev, L. D.; Shchelkachev, A. V. (Gosudarstvennyi Komitet po Ispol'Zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The real parts of forward pion-nucleon scattering amplitudes are found from dispersion relations at wide energy interval from 10 up to 500 GeV. The calculations were carried out on BESM-6 computer. The possibility of the ratio of the real part to the imaginary one of πp-scattering amplitude to be constant and the role of electromagnetic corrections are investigated. (auth)

3917 (ITF-72-83-P) TWO-PARTICLE T-MATRIX FACTORIZATION AND A THREE-NUCLEON PROBLEM WITH GAUSSIAN POTENTIAL. Petrov, N. M. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The problem of motion of two or three nucleons is considered using the approximation of the potential in a momentum representation by a series with separable terms. The two-nucleon and three-nucleon low-energy parameters are calculated for a local Gaussian potential. The obtained results are compared with experiment and the results obtained elsewhere. (auth)

3918 (JINR-P2-7047) INVARIANT VARIETIES OF THE CHEW-LOW EQUATION (CONTINUATION). Meshcheryakov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Set of the Chew-Low equation solutions in the vicinity of the stationary point is described with the help of the group of continuous transformations with additive parameter. The solution of the group equations is found in the form of series. (auth)

3919 (LBL-555) SELECTED TOPICS IN BARYON RESONANCES. Barbaro-Galtieri, A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Aug 1972. Contract W-7405-eng-48. 78p. Dep. NTIS $6.00.

The review lectures on baryon resonances cover resonance formulas and parameters for $\Delta(1236)$, decay of $\Lambda(1520)$ and $\Lambda(1690)$ into $\Sigma(1385) + \pi$, SU(3) fits, and the study of $\Lambda(1405)$ with CDD pole versus the bound state. (JFP)

3920 (RLO-1388-650) OFF-MASS SHELL PARITY-VIOLATING PION-NUCLEON INTERACTION. Henley, E. M.; Keliher, T. E.; Pardee, W. J.; Yu, D. U. L. (Washington Univ., Seattle. Dept. of Physics). 1973. 48p. Dep. NTIS $4.50.

In the usual theoretical description of parity violation, off-mass shell effects of the weak pion nucleon interaction are neglected. In the Cabibbo theory, the weak parity-violating pion-nucleon vertex is then proportional to $\sin^2\theta \approx 0.05$ as it arises only from strangeness-changing weak currents. If off-mass shell effects are taken into account, then a vertex proportional to $\cos^2\theta$ is possible. An effective $\cos^2\theta$ pion-nucleon interaction is derived by means of the renormalizable σ-model. An effective dimensionless coupling estimate is obtained which is roughly given by $Gg\,\vec{\tau}\cdot\phi\,\Delta M/M$ if the nucleon is time-like and half off its mass shell by ΔM. Thus neutral, as well as charged weak pion-nucleon couplings of sizable strengths ($\sim 10^{-6}$), are predicted by this model even though no neutral weak currents are invoked. (auth)

3921 STUDY OF THE I = ½ $p\pi\pi$ SYSTEM IN 10 GeV/c K^+p INTERACTIONS. Colley, D. C. (Univ. of Birmingham, Eng.); Jobes, M.; Jones, G. M.; Milne, J.; Hughes, I. S.; McCormick, J. W. P.; Turnbull, R. M.; White, I. R.; Alper, B.; Bowler, M. G.; Saxon, D. H. Nucl. Phys.; B55: No. 1, 1-14(1973).

The peripherally-produced $p\pi^+\pi^-$ system from the reaction $K^+p \to K^+p\pi^+\pi^-$ was studied for $p\pi^+\pi^-$ masses less than 1.9 GeV/c_2. Analysis of the angular distributions of the normal to the $p\pi\pi$ decay plane and a model-dependent analysis of the Dalitz plot and decay angular distributions both show that more than one spin-parity state is present throughout the region. For $p\pi^+\pi^-$ masses less than 1.5 GeV/c^2 J^P in the $\Delta\pi$ system is predominantly $^3/_2^-$ while above 1.6 GeV/c $J^P = {}^5/_2^+$ and $^1/_2^+$ are both significant while there is a substantial non-$\Delta\pi$ contribution at all masses. None of our $\Delta\pi$ amplitudes show clearly defined resonant behavior. (auth)

3922 AMBIGUITIES IN REGGE ANALYSES OF BACKWARD SCATTERING. Storrow, J. K.; Winbow, G. A. (Daresbury Nuclear Physics Lab., Eng.). Nucl. Phys.; B54: No. 2, 560-572 (1973).

Ambiguities in Regge analyses of backward scattering due to the possibility of $\sqrt{u}$ dependence in trajectory and residue functions of fermion Regge poles are investigated. Experiments to clarify the ambiguities are suggested. Also an intrinsic difficulty in separating exchanges of opposite parity is discussed. (auth)

3923 HIGH-ENERGY REACTIONS SEEN FROM THE S-CHANNEL: A COMPLEX POLE IN THE IMPACT PARAMETER PLANE. Schrempp, B.; Schrempp, F. (Univ., Hamburg). Nucl. Phys.; B54: No. 2, 525-551(1973).

An s-channel model for inelastic reactions at high energies is presented. The scattering amplitude is split up into the contribution from the right-hand cut ($T^{r.h.c.}$) and that from the left-hand cut ($T^{l.h.c.}$) in a fixed-t dispersion relation; $T^{r.h.c.}$ is assumed to be dominated by the peripheral s-channel resonances associated with a complex pole b_0 (s) in the impact-parameter plane. It yields the rotating-phase part of the amplitude; $T^{l.h.c.}$ is assumed to be the analytic continuation of the analogous term in the u-channel. It provides a real, non-peripheral background in the s-channel. The predictions of this model for the t-dependence of high-energy amplitudes are confronted with experiment. A very good agreement is found in all cases. Moreover, an analytic expression for the complex pole trajectory b_0 (s) is presented, which agrees with the experimentally determined one and with analyticity requirements. This crucially interlocks the two terms $T^{r.h.c.}$ (being a function of b_0 (s)) and $T^{l.h.c.}$ (being a function of b_0 (u)). (auth)

3924 DUAL PROPERTIES OF INCLUSIVE SPECTRA. Chan, H. M.; Miettinen, H. I.; Roberts, R. G. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys., B54: No. 2, 411-428(1973).

The dual properties of the inclusive reaction $\pi^-p \to pX$ are studied over a wide energy range by exploiting the scaling behavior. Semi-local duality is found to be well satisfied. An energy-dependent triple-Regge analysis reveals a strong triple-pomeron coupling. There is some evidence of an abnormal component in which diffractively produced resonances are dual to pomeron exchange. Combining duality with factorization leads to relations between production cross sections of meson and baryon resonances in πp and pp collisions which are compatible with existing experimental data. (auth)

3925 REACTION $\pi^-p \to \pi^0n$ AT HIGH ENERGIES. Sukhorukov, S. T.; Ter-Martirosyan, K. A. (Inst. for Theoretical and Experimental Physics, Moscow). Nucl. Phys.; B54: No. 2, 522-524(1973).

In connection with recent experimental data the properties of the reaction $\pi^-p \to \pi^0n$ are considered using Regge-cut theory. (auth)

3926 CONTINUOUS MOMENT SUM RULES AND REGGE AMPLITUDES FOR PION-NUCLEON SCATTERING. Lyberg, M. D. (Univ. of Copenhagen). Nucl. Phys.; B55: No. 2, 573-586 (1973).

Using continuous moment sum rules and phase-shift data as the only input, Regge-parametrized amplitudes for pion-nucleon scattering are derived. These amplitudes can to great accuracy reproduce high-energy differential cross section and polarization data. They also agree in detail with other model amplitudes and reproduce fairly well the pion-nucleon s-channel helicity amplitudes at the energies where a complete analysis of pion-nucleon scattering has been performed. It turns out to be important that the integration of the amplitude over the unphysical range is treated with care. (auth)

3927 RADIATIVE CAPTURE OF $\bar{K}$-MESONS BY NUCLEONS. Krive, I. V.; Kulish, Yu. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 416-420(Mar 1973). (In Russian).

Reactions of radiative capture of $\bar{K}$-mesons by nucleons $\bar{K} + N \to Y + \gamma$; $Y = \Lambda, \Sigma$ are considered near a threshold in the pole model (Born approximation, Λ^* (1405) in s-canal). If only the Born approximation is accounted for, a noticeable decrease in probability of neutral hyperon production on neutrons as compared to probability of their production on protons is marked. The ratios of squared amplitudes of the reactions $\bar{K} + N \to Y^0 + \gamma$ with consideration of Λ^* (1405)-resonance proved to be close to unit. Estimations show that the reactions $\bar{K} + N \to Y^0 + \gamma$ near a threshold may turn out to be an effective means for studying Λ^* (1405) $\to Y^0 + \gamma$ radiative decays. (auth)

3928 DISPERSION-RELATION ANALYSIS OF K^+p SCATTERING BELOW 2 GeV/c. Martin, B. R.; Miller, C. E. (University Coll., London). Nucl. Phys.; B54: No. 1, 227-236(1973).

K^+p scattering amplitudes are obtained that fit a large body of data below 2 GeV/c, satisfy phenomenological partial-wave and backward dispersion relations, and are consistent with forward dispersion relations for the spin-non-flip amplitude, and forward dispersion-relation sum rules for the K^+p P-wave scattering lengths. This has been achieved by firstly making an energy-dependent phase-shift analysis of 1,660 pieces of K^+p data below 2 GeV/c, using parameterised partial-wave dispersion relations, with the additional constraints of forward dispersion relations and P-wave scattering lengths obtained from forward dispersion-relation sum rules, and then checking the resulting solutions for consistency with backward K^+p dispersion relations. (auth)

3929 TESTS OF THE ABSENCE OF EXOTIC EXCHANGES. Halzen, F. (Univ. of Wisconsin, Madison); Mandula, J.; Zweig, G.; Weyers, J. Contract AT(11-1)-68. Nucl. Phys., B54: No. 1, 199-216(1973).

Many relations which sensitively express the suppression of exotic exchanged quantum numbers are derived and compared with the available data. (auth)

3930 RELATIVISTIC MODEL OF QUARK-QUARK STRONG INTERACTIONS. Animalu, A. O. E. (Drexel Univ., Philadelphia). Lett. Nuovo Cim.; 6: No. 13, 504-508(31 Mar 1973).

The implications for hadron bound states and mass spectra are investigated for the assumptions that the constituents of hadrons are quarks (q) and/or antiquarks ($\bar{q}$) and that the strong interaction between any q-q, q-$\bar{q}$, or $\bar{q}$-$\bar{q}$ pair is described by a long-range potential of the form g^2/r at a separation r, g being the strong coupling constant that characterizes the Yukawa short-range nucleon-nucleon potential. The mass spectrum of the $^1/_2^+$ baryon octet in 0(4,2) and that of the 0^- meson nonet on 0(4,2) are found. (JFP)

3931 MATRIX PADE APPROXIMATE IN πN SCATTERING. Turchetti, G. (Istituto Nazionale di Fisica Nucleare, Bologna). Lett. Nuovo Cim.; 6: No. 13, 497-503(31 Mar 1973).

The matrix Pade approximants are worked out explicitly for the $\pi + N \to \pi + N$ amplitude. (JFP)

3932 ANALYSIS OF THEORETICAL AND EXPERIMENTAL DATA ON THE MULTIPLICITY OF SECONDARY PARTICLES FOR HIGH ENERGY NUCLEON-NUCLEON AND PION-NUCLEON INTERACTIONS. Avakyan, V. V.; Keropyan, M. I.; Mamidzhanyan, E. A. (Inst. of Physics, Erevan). Yadern. Fiz.; 16: No. 4, 759-763(Oct 1972). (In Russian).

The collection of world experimental data on the multiplicity $\langle n_s \rangle$ of the secondary charged particles of nucleon-nucleon and pion-nucleon interactions is given in 5 to 5.10^4 GeV energy region. All theoretical models, which predict the dependence of $\langle n_s \rangle$ as a function of primary energy E_0 is analyzed. The semi-empirical formula, which properly describes all correct experimental data on $\langle n_s \rangle$ for nucleon-nucleon interactions is obtained for 10 to 10^4 GeV energy region. According to the calculation $\langle n_s \rangle = (3.8 \pm 0.1) + (0.13 \pm 0.01)E_0^{\frac{1}{4}}$. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 4034.

3933 (COO-3001-35) NUCLEON-NUCLEON INTERACTION FROM PION-NUCLEON PHASE SHIFT ANALYSIS. Vinh Mau, R.; Richard, J. M.; Loiseau, B.; Lacombe, M.; Cottingham, W. N. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)-3001. 26p. Dep. NTIS $3.50.

The low-energy peripheral nucleon-nucleon partial wave phase parameters are calculated from the present knowledge of pion-pion and pion-nucleon phase shifts. The results are compared with phenomenological energy independent and energy dependent phase shift analyses. (auth)

3934 (ITF-72-93-P) DIFFRACTIONAL PROTON SCATTERING BY A DEFORMED NUCLEUS. Dotsenko, I. S.; Fursa, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The proton scattering by ^{12}C is considered in a diffraction approximation. To describe the states of ^{12}C the wave functions were used which are constructed of one-particle functions describing the nucleon states in an averaged potential of anisotropic harmonic oscillator. The elastic and inelastic (with the 2^+ level excitation) cross section of proton scattering with the energy 1000 MeV are calculated. A calculation is carried out in the approximation of small deformations. The parameter of deformation of ^{12}C is obtained from the condition of the best agreement of the calculated cross section of elastic scattering and experimental data. (auth)

3935 (NP-19741) NOTE ON PERTURBATION THEORY FOR THREE-PARTICLE SCATTERING. Bencze, Gy.; Doleschall, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1972. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Arguments are given that the Alt-Grassberger-Sandhas (AGS)-type perturbation theory is to be preferred to that developed by Sloan and Pieper. It is shown that the first order AGS approximation can be trivially incorporated into the formalism of the three-particle equations. The AGS perturbation theory is applied to n-d scattering, and the results are compared to those of the exact calculations. (auth)

3936 K-MESIC ATOM. Three-body K^-d Model. Myhrer, F. Ark. Fys. Seminar Trondheim; No. 5, 1-9(1973).

Assuming that the $Y_0(1405)$ resonance dominates the $\bar{K}N$ system at threshold, it is shown in a three-body K^-d model that to get the correct sign of the real part of the kaon-nucleus optical potential, we must use an off-shell $\bar{K}N$ amplitude and that higher $\bar{K}N$ multiple scattering including intermediate nuclear excitations is important. (auth)

3937 INELASTIC INTERACTIONS OF HIGH ENERGY HELIUM IONS WITH ATOMIC NUCLEI. Barashenkov, V. S.; Gudima, K. K.; Zheregi, F. G.; Il'inov, A. A.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 2, 434-440 (Feb 1973). (In Russian).

Inelastic collisions of helium ions with energy larger than some tens of MeV/nucleon are calculated on the basis of model of intranuclear cascade, accompanied by evaporation process (or fission) of excited nucleons—"residue." The effect of decreasing nucleon number density in nucleus target in the course of intranuclear cascade development is discussed. An approximated model where incident α-particle is in the form of four independent nucleons was considered separately. The calculation results are in accord with experimental data. (auth)

3938 PERTURBATIVE DESCRIPTION OF THE POMERON SUGGESTED BY THE TWO-COMPONENT MODEL OF MULTIPARTICLE PRODUCTION. Bishari, M.; Koplik, J. (Univ. of California, Berkeley). Phys. Lett.; 44B: No. 2, 175-178(16 Apr 1973).

The two-component model of multiparticle production is interpreted as the zeroth order term in an expansion in powers of the triple pomeron coupling. This leads to an S-matrix perturbative description of the pomeron in terms of measurable quantities. The first order corrections are calculated and it is shown that the breaking of factorization can differ significantly from that expected in the two-component model. Rough numerical estimates are also given. (auth)

3939 GRIBOV'S REGGEON CALCULUS AND HIGH-ENERGY ELASTIC PROTON-PROTON SCATTERING. Ng, J. N.; Sukhatme, U. P. (Univ. of Washington, Seattle). Nucl. Phys.; B55: No. 1, 253-265(1973).

It is demonstrated that the change of slope at $t \simeq -0.1(GeV/c)^2$ and the dip at $t \simeq -1.4(GeV/c)^2$, observed in the recent ISR proton-proton elastic-scattering data, can both be simultaneously explained within the framework of Gribov's reggeon calculus for the pomeron. (auth)

3940 RISING $d\sigma/dt$ PROBES pp DIFFRACTION MECHANISMS. Barger, V. (Univ. of Wisconsin, Madison); Phillips, R. J. N.; Geer, K. Nucl. Phys.; B54: No. 2, 463-468(1973).

The s-dependence of $d\sigma/dt$ at fixed t reveals important features of the underlying mechanism. In particular, it can clarify the origin of the structure near $t = -1.2$ in high-energy pp elastic scattering. If this structure comes from destructive interference between two terms of different energy dependence (e.g. between single and double pomeron exchanges), the plot of $\ln d\sigma/dt$ versus $\ln s$ in the interference region will show an inflexion or dip; $d\sigma/dt$ may even rise with increasing s through a limited interval. Other mechanisms have no such feature. Illustrations are given and the interest of measurements in the NAL and ISR momentum range is stressed. (auth)

3941 HADRON COLLISIONS AT HIGH TRANSVERSE MOMENTUM. Cline, D.; Halzen, F.; Waldrop, M. (Univ. of Wisconsin, Madison). Contract AT(11-1)-881. Nucl. Phys.; B55: No. 1, 157-166(1973).

Recent experiments at the CERN ISR measuring hadron collisions at high transverse momenta (p_T), show clear deviations from the sharp exponential cut-off observed at small p_T. It is shown that the cross sections fall as a power of p_T as expected from point-like interactions of the hadrons, similar to those observed in electroproduction experiments. From simple parton-model calculations it is estimated (in agreement with the data) that $pp \to \pi^0 +$ anything falls as p_T^{-8} at constant incident energy and grows as s^2 at fixed p_T. Within the same model large-angle pp elastic scattering should scale as $(d\sigma/dt)(pp \to pp) = s^{-10}F(\cos\theta)$. Although not conclusive, the present data strongly suggest such behavior. (auth)

3942 INTERMEDIATE ENERGY NUCLEON-DEUTERON SCATTERING THEORY. Wilson, J. W. (Langley Research Center, Hampton, Va.). Phys. Lett.; 44B: No. 2, 125-126(16 Apr 1973).

Sloan's conclusion for an S-wave separable model, that terms of the multiple-scattering series beyond single scattering contribute only to S- and P-wave amplitudes is examined. Comparison of experiment with the present calculation at 146 MeV shows that these conclusions are applicable to nucleon-deuteron scattering. (auth)

3943 WHAT CAN WE LEARN ABOUT THE REGGE PLANE FROM pp CROSS SECTIONS? O'Hara, D.; Squires, E. J. (Univ. of Durham, Eng.). Nucl. Phys.; B54: No. 1, 161-169(1973).

pp total and differential cross sections from $s = 10\ (GeV)^2$ upwards were analyzed in terms of singularities in the Regge plane. The data can be fitted by poles alone but a considerably more continuous discontinuity structure is possible. An interpretation of the pole residues in terms of expected Regge poles runs into difficulties at some values of t. (auth)

3944 MODEL SIMULATION OF FOUR-PRONG P-P INTERACTIONS WITH MOMENTA OF 19.1 GeV/c. Part I. Boos, E. G.; Zhautykov, B. O.; San'ko, L. A.; Kuz'mina, V. L. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 4, 57-62(1972). (In Russian).

Model simulation was conducted of reactions in the two-meter hydrogen bubble chamber of CERN for a momentum of the primary proton of (19.07 ± 0.04) GeV/c. The program FORS was used for generation, and to compute the angular distribution of protons in the system of center of mass of interaction. The limiting values of the deficient mass M_0^2 and the criterion x for separation of the channels were obtained. Contributions from other channels were practically not observed in a channel without neutral particles. (tr-auth)

3945 EXPERIMENTAL TEST OF A TWO-MECHANISMS MODEL. Giovannini, A. (Univ., Turin). Lett. Nuovo Cim.; 6: No. 13, 514-518(31 Mar 1973).

Attention is drawn to a previous model which predicts precocious scaling and agrees quite well with experiments. Proton-proton collisions at 50 to 303 GeV/c are discussed. (JFP)

3946 SLOPE PARAMETER OF THE DIFFERENTIAL CROSS SECTION FOR pp-SCATTERING. Chernev, Kh. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 4, 755-758(Oct 1972). (In Russian).

The dependence of the slope parameter of differential cross section for elastic pp-scattering upon the Mandelstamm variable $s\ (18 \le s \le 2800\ GeV^2)$ and $t\ (0.015 \le |t| \le 0.45\ (GeV/c)^2)$ was studied. For one pole model the pole trajectory slope was

defined. The value of the coefficient c was determined in parametric representation of elastic pp-scattering cross section $d\sigma/d|t| = \exp(a + bt + ct^2)$ for the energy range 10 to 1000 GeV. (auth)

Particle Invariance Principles and Symmetries

General

3947 (KFKI-73-7) UNITARY REPRESENTATIONS OF THE SL(2,C) GROUP IN HOROSPHERIC BASIS. Huszar, M. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1972. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

The matrix elements of unitary representations of the SL/2,C/ group are derived in a basis defined by two-dimensional momenta corresponding to the horospheric subgroup $\begin{pmatrix} 1 & \delta \\ 0 & 1 \end{pmatrix}$. The representations are expressed in a rather simple form in terms of Bessel functions. (auth)

3948 O(3) SHIFT OPERATORS AND THE GROUPS O(4), O(3,1), AND E(3). Hughes, J. W. B. (Queen Mary Coll., London). J. Phys., A (London); 6: No. 4, 445-452(Apr 1973).

Operators shifting the eigenvalues of the O(3) Casimir are constructed from the members of a three-dimensional tensor representation of O(3), and used to give a unified derivation of irreducible representations of the groups O(4), O(3,1) and the euclidean group E(3). (auth)

3949 EFFECTIVE LAGRANGIANS AND BROKEN SYMMETRIES. Zumino, B. (CERN, Geneva). pp 437-500 of Lectures on Elementary Particles and Quantum Field Theory. Vol. II. Deser, S. (ed.). Cambridge, MA; Massachusetts Inst. of Tech. Press (1970).

An attempt is made to give a precise meaning to the effective Lagrangian as being the functional which generates the one-particle irreducible vertices. The method of effective Lagrangian or effective action is then applied to the study of some spontaneously broken symmetries, in particular chiral and conformal symmetry. (LBS)

3950 GEOMETRIC APPROACH TO INVESTIGATION OF KINEMATICAL SYMMETRIES OF FREE PARTICLE SYSTEMS. Klepikov, N. P.; Bogoslovskii, G. Yu. (Moscow State Univ.). Yadern. Fiz.; 16: No. 4, 863-872(Oct 1972). (In Russian).

A set of coordinates and time of free relativistic particle system is treated as Finsler space. For such a space the Killing equations are generalized. The symmetry of this is being studied with their help. On the mass shell a spherical geometry is introduced, the hyperspherical functions are used as basic ones in the expansion of relativistic multiparticle amplitudes. (auth)

Applications (Electromagnetic and Weak)

3951 (RLO-1388-640) ELECTROMAGNETIC PARITY VIOLATION FOR HADRONS. Henley, E. M.; Huffman, A. H.; Yu, D. U. L. (Washington Univ., Seattle. Dept. of Physics). 1972. 9p. Dep. NTIS $3.00.

It is argued that a first-order weak direct parity-violating electromagnetic interaction should exist for hadrons. The interaction vanishes for real photons if the initial and final hadrons are identical and if off-mass-shell effects are neglected; the interaction contributes to reactions where this is not the case or for virtual photons. Estimates of the magnitude of parity-violating effects are made for nuclear electromagnetic transitions and for electron-proton elastic scattering. It is shown that asymmetries $\approx 10^{-6}$–10^{-5} can be expected in 20-GeV elastic electron scattering from polarized protons. (auth)

3952 (RLO-1388-643) EXCHANGE EFFECTS IN NUCLEAR PARITY-VIOLATIONS. Henley, E. M. (Washington Univ., Seattle. Dept. of Physics; Los Alamos Scientific Lab., N. Mex.). Oct 1972. 12p. Dep. NTIS $3.00.

Exchange effects are examined for nuclear parity violating experiments which use photons as detectors. The weak coupling to vector (or axial vector) mesons which decay to $\pi\gamma$ are treated in detail. The effect is found to be small ($\lesssim 10^{-3}$) unless the existence of a recent $\pi\gamma$ resonance observed at 270 MeV is confirmed. (auth)

3953 SPONTANEOUS BREAKING OF GAUGE SYMMETRIES WITH NON-LINEAR REALIZATIONS. Gottlieb, H. P. W. (Imperial Coll. of Science and Tech., London). Nucl. Phys.; B54: No. 2, 509-521(1973).

Spontaneous breaking of gauge symmetries by nonlinear realizations involving scalars is used to obtain a gauge-invariant massive-vector-meson formulation. (auth)

Applications (Strong)

3954 (IC-73/22) VECTOR AND TENSOR GAUGE PARTICLES IN SL(6,C) THEORY. Isham, C. J.; Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Mar 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

To the SL(6,c) gauge-invariant Lagrangian presented earlier, an additional SL(6,c) invariant term is added which allows for the propagation of 1^- and 1^+ massive nonets in addition to the nonet of 2^+ particles. (auth)

3955 (ITF-72-81-E) BROKEN NONLINEAR CHIRAL SU(2) × SU(2) DYNAMICS INDEPENDENT OF PARAMETRIZATION. Gulii, V. N.; Sabo, V. Ya. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that it is possible to introduce into the linear chiral SU(2) × SU(2) dynamics of πN-system a mass pion term which breaks the symmetry up to SU(2) in such a way that the amplitudes of binary processes in the tree approximation on the mass shell do not depend on parametrization. (auth)

3956 BARYON MULTIPLETS OF SU_3-SYMMETRY. Kostyrko, I. I. (Inst. of Mathematics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 504-507(Mar 1973). (In Russian).

A generalized principle of equivalence was proposed which was used to calculate average masses of baryon incompleted SU_3-multiplets with large spins. (tr-auth)

3957 ^{8}Be NUCLEUS CLUSTER STRUCTURE. Vashakidze, I. Sh.; Dzhalaganiya, T. R. (Tbilisi State Univ., USSR). Yadern. Fiz.; 16: No. 4, 681-688(Oct 1972). (In Russian).

Be^8 nucleus structure is studied, using α-particle model. The energies of the ground and excited states with positive parity are considered. Realistic nucleon–nucleon potentials were taken as nuclear interactions. The rotational spectrum, 0^+, 2^+, 4^+ levels in particular, and the dependence of the corresponding energies upon the distance between α-clusters are being studied with the help of multicentral projected Slatter determinants. Specific calculations show, that in spite of the fact that the nucleus binding energy in its absolute value is larger than the experimental one, nevertheless the distances between the rotational levels coincide satisfactorily with the experimental data. The energy minimum is obtained at the distance 3–4 fm between α-clusters. (auth)

Scattering Theory

Refer also to abstracts 3923 and 4046.

3958 (JINR-E2-6926) CLASS OF S-MATRIX PROBLEMS WITH A WEAKENED CONDITION OF ANALYTICITY. Nedelkov, I. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

In the framework of s-matrix theory, the partial scattering amplitudes are sought as a solution of a certain problem involving analyticity, unitarity and crossing symmetry. This problem, with a condition of analyticity which is weaker than the usual one, is called Low's problem. By means of the fixed-point theorem of Schauder, conditions for the existence of solutions to Low's problem are given. (auth)

3959 (JINR-E2-6992) EXTENSION OF THE S-MATRIX OFF THE MASS SHELL AND MOMENTUM SPACE OF CONSTANT CURVATURE. Donkov, A. D.; Kadyshevsky, V. G.; Mateev, M. D.; Mir Kasimov, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 87p. (CONF-721219-3). Dep. NTIS (U. S. Sales Only) $6.50.

In the framework of Bogolubov's axiomatic approach problems connected with the extension of the scattering matrix off the mass shell are considered. In the method of extended S-matrix the concepts of elementary particle interactions accepted in quantum field theory are reflected to most complete extent. It is demonstrated that the off mass shell S-matrix extension in the spirit of De-Sitter p-space geometry can be made consistent with the requirements of relativistic invariance, unitarity, spectrality, completeness of the system of asymptotic states. With the help of a specific Fourier transform in momentum space of constant curvature a new configuration ξ-space is introduced, whose geometry for small distances $\lesssim l_0$ is essentially different from the pseudoeuclidean one. The causality condition on the S-matrix, which is direct generaliza-

tion of Bogolubov's causality condition, going to it in the limit $l_0 \to 0$, is formulated in terms of this ξ-space. On several examples it is demonstrated that in the developed theory the problem of generalized singular function products loses its acuteness. In particular the commutation functions and propagators in the new scheme can be interpreted as usual (not generalized) functions and there is no arbitrariness in any of their powers and products. (auth)

3960 (ORO-4317-18) BOUNDARY-CONDITION APPROACH TO THREE-PARTICLE FINAL STATES. Technical Report No. 73-106. Brayshaw, D. D. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Apr 1973. 25p. Dep. NTIS $3.25.

It is shown that the wave function for a three-particle system outside the range of forces may be uniquely determined by imposing a suitable set of boundary-conditions. This result is expressed in terms of a one-variable integral equation with a square-integrable kernel, the solutions of which specify the three-body t-matrix. The input to this equation consists of the two-particle phase shifts and two independent real-valued functions which characterize the three-body wave function in specific regions. The formalism yields an exactly unitary three-particle t-matrix for arbitrary values of this input, and thus provides a practical scheme for the analysis of three-body final states. (auth)

3961 POMERANCHUK BRANCHINGS IN DUAL RESONANCE MODEL AND TOTAL CROSS SECTIONS AT HIGH ENERGIES. Laperashvili, L. V.; Safro, M. G. (Inst. of Physics, Tbilisi, USSR). Yadern. Fiz.; 17: No. 2, 423-433(Feb 1973). (In Russian).

The behavior of total cross section for elastic scattering at high energies was studied with the assumption, that main contribution to the cross section is made by Pomeranchuk pole and Pomeranchuk branchings, described by dual resonance theory. It is shown, that in dual resonance model (DRM) $\xi = \ln(\alpha' s) \gg \pi$ is a condition of validity for known extremely asymptotic expressions for branchings. Besides energy dependences of the ratio of branching contribution to the total amplitude and ratio of the amplitude real part to the imaginary one for a forward scattering were studied. It is shown, that DRM predicts a very slow vanishing of branching contributions with energy increases. (auth)

3962 COMPLEX REGGE POLES AND THE SIGN OF THE TWO-POMERANCHON DISCONTINUITY. Chew, G. F. (Univ. of California, Berkeley). Phys. Lett.; 44B: No. 2, 169-170(16 Apr 1973).

The threshold increase of the two-fireball cross section, with one fireball of large mass and one of small is discussed in terms of complex Regge poles and the sign of the two-Pomeranchon discontinuity. It is shown that even though the cut in the complete amplitude is positive, an approximate Regge representation without complex poles, suitable for a limited energy region, may contain a negative cut. A connection is made between the triple Pomeranchon coupling and the amplitude of the cross section oscillation associated with the complex poles. (auth)

3963 APPROXIMATION OF SCATTERING AMPLITUDES USING ANALYTICITY AND EXPERIMENTAL DATA. Pietarinen, E. (NORDITA, Copenhagen). Nucl. Phys.; B55: No. 2, 541-550(1973).

The representation of scattering amplitudes by analytic functions is studied with particular emphasis on the generality of the method. An application of the Hilbert-space approximation techniques leads to a unified procedure, which properly takes into account the statistical nature of the experimental data. (auth)

3964 DYNAMICS OF MULTIPLE-REGGEON EXCHANGE CUTS. Craigie, N. S.; de la Torre, A. (Univ., Heidelberg). Nucl. Phys.; B55: No. 2, 551-572(1973).

The circumstances under which multiple-pomeron exchange amplitudes can become iterative are discussed and it is shown how the intermediate states involved in these amplitudes can be related to the states produced in diffractive dissociation. In order to obtain a soluble model, a simple integral equation is constructed, which in an iterative way leads to a multi-pomeron exchange series, including contributions of cut mechanisms involving spectator particles. From a particular solution of this equation it is illustrated how the longitudinal-momentum distributions of the diffractive intermediate states influence the relative strength of the cuts. Further from a qualitative analysis, it is shown why one might expect the helicity-non-flip vacuum amplitudes to have strong cuts, while all other amplitudes have weak cuts. A number of related points are also discussed. (auth)

3965 CRICHTON'S PHASE-SHIFT AMBIGUITY. Atkinson, D.; Johnson, P. W.; Mehta, N.; de Roo, M. (Instituut voor Theoretische Natuurkunde, Groningen, Netherlands). Nucl. Phys.; B55: No. 1, 125-131(1973).

A re-examination of the SPD phase-shift ambiguity is made with a view to understanding certain singular features of the elastic unitarity constraint. An explicit solution of Crichton's equations is presented, and certain features of this solution are displayed graphically. In particular, it is shown that there are two critical values of the D-wave phase shift, for which the locally linearized unitarity equation has a bifurcation point, for which the modulus of the amplitude has a zero at a physical point, $-1 < \cos\theta < 0$, and for which the real part has in addition a zero at $\cos\theta = 1$. (auth)

3966 PAIRING IN MULTIPARTICLE AMPLITUDES: INCLUSIVE DISTRIBUTIONS. Steinhoff, J. (Univ. of Chicago). Nucl. Phys.; B55: No. 1, 132-156(1973).

A model for multi-pion production in the central region in high-energy collisions is studied which describes factorizable emission of pion pairs. A mathematical identification between the exclusive cross section for pion emission in our model (with all interference terms) and the configurational probability distribution function for a classical system of interacting molecules in equilibrium is exploited to obtain an expansion for the asymptotic single-particle inclusive distribution, the two-particle inclusive correlation function, and the exponent of s in the total cross section by means of cluster diagrams. An integral equation is exhibited for summing the terms corresponding to the cluster diagrams. A specific model is then considered, which is called "s-channel pole dominance". In this model the amplitude is assumed to be large only when the subenergies of pairs of pions are near the mass of a low-lying two-pion resonance, and the transverse momentum of each resonance is small. The dependence of the amplitude on other variables is ignored, so that independent emission of two-pion resonances with non-zero width is effectively obtained. It is seen that an $I = 0$ or $I = 1$ resonance results in a positive two-particle inclusive $I = 2$ correlation function at small rapidity separations, as $s \to \infty$, and that the correlation function can have an exponential "tail" in rapidity of qualitatively longer range than the resonance. A crude numerical simulation of a broad $I = 0$ spinless resonance is discussed, and the resulting $I = 2$ inclusive correlation function is seen to be quite large at small rapidity separations, and to have the same exponential "tail" as the $I = 0$ correlation function. (auth)

3967 ABSENCE OF GHOST IN THE DUAL POMERON. Neveu, A. (Inst. for Advanced Study, Princeton, NJ). Nucl. Phys.; B54: No. 2, 429-431(1973).

It is shown that the ghost state found recently by Cremmer and Scherk in the dual pomeron is due to an incorrect treatment of massless spin-two states. (auth)

3968 APPLICATION OF CONTINUED FRACTIONS TO BOUND STATE AND SCATTERING PROBLEMS. Biswas, S. N.; Vidhani, T. (Univ. of Delhi). J. Phys., A (London); 6: No. 4, 468-477(Apr 1973).

The logarithmic derivative of the wave function was put in the form of an infinite continued fraction by the repeated use of successive differentiations of the Schroedinger equation. The eigenvalues and eigenfunctions for bound states were obtained either by terminating or by a suitable procedure of summing the infinite continued fraction. Various examples were considered. For scattering problems the relevant Jost function was calculated from the various convergents of the continued fraction. The resemblance of the procedure to the Padé approximants was noted. The results on phase-shift calculation were compared with those obtained by other means. (auth)

3969 CONSTRUCTION OF A UNITARY ANALYTIC SCATTERING AMPLITUDE. I. Scalar Particles. Atkinson, D.; Mahoux, G.; Yndurain, F. J. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; B54: No. 1, 263-284(1973).

By imposing $\cos\theta$ analyticity, earlier investigations into the problem of constructing a unitary scattering amplitude from experimental measurements are extended. The new approach is superior to earlier work, inasmuch as (a) the partial waves fall off exponentially, (b) cross sections with zeros can be treated, (c) a convergent Newton-Kantorovich iteration is obtained even when the fixed-point theorems do not apply, (d) bifurcation points can be studied, (e) in the inelastic region, it is found that analyticity does not remove the continuum ambiguity, (f) for quasi-elastic reactions (e.g. photoproduction) the Watson ambiguity for the phase shifts is resolved. (auth)

3970 PROJECTIVE INVARIANCE OF DUAL-RESONANCE MODELS FROM SPIN ANALYTICITY AND LORENTZ INVARIANCE. Paciello, M. L. (Univ., Naples); Sciarrino, A.; Taglienti, B. Nuovo Cim., 14A: No. 3, 591-604(1 Apr 1973).

The problem of the origin of the projective invariance of the dual-resonance models is investigated. An explanation in terms

of the Lorentz group is suggested via the definition of generalized spinor amplitudes in which the external "particles" are assigned to unitary, irreducible representations of $SL_{2,C}$. A generalization of the Virasoro amplitude for external spinning particles is obtained. (auth)

3971 CROSSING RELATIONS FOR THE INFINITE-MOMENTUM FRAME HELICITY SCATTERING AMPLITUDES. Yunn, B. C. (Johns Hopkins Univ., Baltimore). Nuovo Cim., 14A: No. 3, 621-632(1 Apr 1973).

Crossing properties of infinite-momentum frame helicity amplitudes are studied. It is found that the crossing matrix simplifies drastically in the limit when an appropriate channel energy tends to infinity, while the momentum transfers are kept fixed. Thus infinite-momentum frame techniques constitute an appropriate kinematical framework for the description of high-energy fixed-momentum-transfer processes. (auth)

3972 INTRODUCTION OF INTERNAL COORDINATES INTO THE INFINITE-COMPONENT MAJORANA EQUATION. Barut, A. O.; Duru, I. H. (International Centre for Theoretical Physics, Trieste, Italy). Proc. Roy. Soc. (London), Ser. A; 333: No. 1593, 217-224(1 May 1973).

Given an infinite-component wave equation describing the global quantum numbers of a system one can introduce various internal dynamical coordinates such that "constituents" will appear to move in an oscillator or in a Kepler potential, or, in principle, in other potentials. This is explicitly shown for the Majorana equation. The space-like solutions of the Majorana equations correspond to the scattering state-solutions in terms of the constituent "particles." Light-like solutions and a generalized second-order Majorana equation are also treated in a similar way. Relation to Dirac's new wave equation without negative energy solutions is discussed. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

3973 KINETIC THEORY OF THE DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He. I. Thermodynamics and Equations of Motion. Disatnik, Y.; Yaniv, A. (Tel-Aviv Univ., Israel). J. Low Temp. Phys.; 10: No. 5-6, 595-620(Mar 1973).

A semimicroscopic kinetic theory of the dilute solutions of ^{3}He in superfluid ^{4}He is presented. The theory considers only phonon and ^{3}He quasi-particle excitations and is therefore applicable at temperatures of up to about 0.6 K. The model underlying the theory utilizes a modified Landau–Pomeranchuck ^{3}He energy spectrum and a second-order momentum expansion for the effective ^{3}He quasi-particle interaction. In addition, it accounts for the effective phonon–^{3}He quasi-particle interaction, to first order in the phonon momentum, by using a renormalized concentration-dependent sound velocity. The simplicity of the model enables the derivation of both a complete equilibrium theory and a complete set of equations of motion for the solutions. The resulting expressions for the thermodynamic properties and the macroscopic currents appearing in the equations of motion represent a useful parametrization of these quantities in terms of the parameters of the model. It is shown that the macroscopic currents can be written in a form which seems to have a simple physical interpretation. As expected, it is found that at local equilibrium the expressions for the currents reduce correctly to the respective phenomenological expressions. (auth)

3974 QUANTUM LATTICE GAS AND THE EXISTENCE OF A SUPERSOLID. Liu, K. S.; Fisher, M. E. (Cornell Univ., Ithaca, NY). J. Low Temp. Phys.; 10: No. 5-6, 655-683(Mar 1973).

The possible phase diagrams of a quantum lattice gas model (as considered by Matsuda and Tsuneto at T = 0) are discussed within mean field theory with particular reference to the existence of a supersolid phase, displaying both long-range diagonal (or crystalline) order and long-range off-diagonal order (as characteristic of a superfluid). For parameter ranges which provide a reasonable representation of the known phase diagram of ^{4}He, it is shown that a supersolid phase may appear between the usual solid and superfluid phases. Such a phase might not, however, extend down to absolute zero. (auth)

3975 DIFFUSION IN ^{3}He NEAR ITS CRITICAL POINT. Flowers, K. A.; Hunt, E. R. (Ohio Univ., Athens). J. Low Temp. Phys.; 10: No. 5-6, 707-713(Mar 1973).

Pulsed NMR techniques were used to measure the spin diffusion coefficient in ^{3}He along eight isotherms between 3.0 and 4.2 K. Densities were also obtained simultaneously from the amplitude of the signal, assuming the magnetization obeys the Curie law. Absolute values of the density were obtained by normalizing to existing data. Although values of $|T-T_c|/T_c$ and $|\rho-\rho_c|/\rho_c$ of less than 10^{-3} were achieved, no anomaly was observed. This is consistent with similar measurements on other substances. The low-density results agree well with previous measurements and theory. (auth)

3976 QUANTUM VORTEXES AND PHASE TRANSITION IN BOSE SYSTEMS. Popov, V. N. (Mathematics Inst., Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 2, 674-680(Feb 1973). (In Russian)

The continual integral formalism for description of quantum vortexes is illustrated for the case of a two-dimensional Bose system. It is shown that a two-dimensional phonon and vortex system is equivalent to relativistic electrodynamics. The phase transition from the superfluid state to the normal involves dissociation of opposite sign vortex pairs. A similar approach to three-dimensional Bose systems leads on to the conclusion that a phase transition to the normal state is accompanied by the appearance of long vortex lines. (auth)

3977 NUCLEAR RESONANCE IN A HYPOTHETICAL SUPERFLUID PHASE OF HELIUM-3. Seiden, J. (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 276: No. 4, 135-138 (22 Jan 1973). (In French).

The likelihood of a superfluid phase of helium 3 between T_C = 2.65mk and T_B = 2mK was investigated. (France)

3978 NUCLEAR RESONANCE AND SOLIDIFICATION CURVE OF LIQUID HELIUM-3 AT VERY LOW TEMPERATURES. Seiden, J. (Paris Univ., Orsay, France). Compt. Rend., Ser. A, B; 276: No. 5, 165-168(29 Jan 1973). (In French).

It is shown that a superfluid phase in ^{3}He between T_C = 2.65mK and T_B = 2mK might explain the experimental observations. (France)

3979 NUCLEAR RESONANCE IN LIQUID ^{3}He AT VERY LOW TEMPERATURES. Seiden, J. (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 276: No. 3, 107-110(15 Jan 1973). (In French).

The following theorem is proposed: the ground state resonance frequency ω_1 for a sufficiently weak field, H_0, is greater or equal to the Larmor frequency γH_0 if the nuclear resonance line is sharp, single, and free from satellites. A brief discussion is then given on the possibility of an ordered liquid phase occurring between T_C = 2.65mK and T_B = 2mK. It is shown that the existence of such a phase would appreciably modify the melting curve. (France)

3980 COOLING BY CONVECTIVE HEAT TRANSPORT IN SUPERFLUID HELIUM. Olijhoek, J. F.; Hoffer, J. K.; Van Beelen, H.; De Bruyn Ouboter, R.; Taconis, K. W. (Rijksuniversiteit, Leiden). Physica; 64: No. 2, 289-305(1 Mar 1973).

Further experiments are described concerning the cooling effect which occurs when liquid He-II is forced to flow through a system consisting of a superleak and fine capillary in series. The nature of this cooling process and the origin of a lower limit which occurs at about 0.75 K, independently of the initial conditions, are the subjects of the present research. In carrying out the experiments at temperatures below 0.75 K, no cooling was detected; instead a warming occurred from which it was possible to calculate the dissipative energy rate. It is found that the "mutual friction" force plays an essential role in the cooling process and that cooling is most likely due to interaction between rotons and moving vortices. (auth)

3981 CRITICAL VELOCITIES AT VERY LOW TEMPERATURES AND THE VORTEXES IN A QUANTUM BOSE FLUID. Sonin, E. B. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 3, 970-983(Mar 1973). (In Russian).

The theory of critical velocities at zero temperature is considered. An investigation of the vortex ring spectrum in a finite cross section channel shows that the Landau critical velocity for vortices vanishes. However the probability for production of a large vortex is very low and hence in a ring channel and at T = 0 persistent helium currents should exist up to velocities close to the critical Landau velocity for a phonon–roton spectrum. It is shown that the region of applicability of the theory for T = 0 is restricted to comparatively low temperatures and small channel lengths. In this connection it is suggested that when the temperature and channel length are reduced to such an extent that the condition for complete disappearance of the normal component obtained is satisfied, a considerable increase of the critical velocities may be expected such that the velocities approach the Landau critical velocity for the phonon–roton spectrum. (auth)

Superconductivity

3982 (AEC-tr-7419) U. S. VISIT OF SOVIET INDUSTRIAL SUPERCONDUCTIVITY SPECIALISTS. Klimenko, E. Yu. Translated from At. Energ. (USSR); 33: No. 6, 1015(1972). 3p. Dep. NTIS $3.00.

3983 (COO–3156-56) FLUCTUATION DIAMAGNETISM OF ALUMINUM AND ALUMINUM ALLOYS ABOVE THE SUPERCONDUCTING TRANSITION TEMPERATURE. Claassen, J. H. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Jan 1973. 142p. Dep. NTIS $9.25.

Thesis.

Thermodynamic fluctuations in the order parameter ψ have been shown to produce a small diamagnetic response at temperatures above the superconducting transition temperature T_c. Gollub, Beasley and Tinkham (GBT) have measured this effect for Pb and In, both pure and with impurities. The functional behavior and values of H_s observed by GBT could not be explained satisfactorily with any theory based on the Ginzburg–Landau formulation. This effect was measured in both pure Al and Al alloys of solute concentration 0.05 and 0.15 at.% Ag and 0.1, 0.3, 0.5, and 0.8 at.% Si. The apparatus used for these measurements included a SQUID magnetometer in a configuration similar to that of GBT which allowed a resolution in sample magnetization of $\sim 2 \times 10^{-9}$ Gauss. The fluctuation magnetization was separated from other contributions by the fact that it is temperature dependent and is completely quenched in sufficiently high fields or temperatures. The apparatus could operate in fields H > 100 Oe and allowed the sample temperature to be raised as high as 5 K. The alloy specimens were polycrystals, and comprised a range of values for ξ_0/l from 2 to 17;

these are all within the range of validity of the microscopic theory, since for Al one finds that $0.18\ \theta_D/T_c \sim 60$. The scaling fields for all the alloys fell considerably below the predicted dependence $H_s = 0.018(\phi_0/\xi_0^2)(1 + 0.88\xi_0/l)^2$, and in fact were somewhat better represented by the results of a calculation by Maki and Takayama which predicts a dependence on mean free path $\sim\xi_0/l$. Some technical details of this calculation have, however, been disputed by the authors of the microscopic theories. (auth)

3984 (LNF-72/104) MEAN LIFE ON PERSISTENT CURRENT IN TWO DIMENSIONAL SUPERCONDUCTOR. Parisi, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 7 Dec 1972. 3p. Dep. NTIS (U. S. Sales Only) $3.00.

Using an approximate form of the time-dependent Landau–Ginsburg equation, it is found that in a two-dimensional system quasi-persistent currents are present, their mean life being exponentially large. (auth)

3985 DIRECT MECHANICAL MEASUREMENT OF PINNING FORCES ON TYPE-II SUPERCONDUCTORS. Eggendorfer, G. (Zentralinstitut fuer Tieftemperaturforschung, Garching, Ger.). J. Low. Temp. Phys.; 10: No. 5-6, 715-733(Mar 1973).

A radially flowing transport current is fed into a disk specimen suspended in a magnetic field perpendicular to the surface, and the torque resulting from the Lorentz forces is measured. Sample and current leads form a closed superconducting circuit. The current induced in this circuit, and thus the torque, can be increased without dissipation until flux flow starts. The torque corresponding to this limit is directly proportional to the pinning force per unit volume. Results for 0.1-mm-thick Nb samples are reported, including the peak effect and a yield phenomenon. The values of the pinning forces are in good agreement with theoretical predictions and of the same order of magnitude as the measurements of other authors. (auth)

3986 SUPERCONDUCTING ENERGY GAPS AND TRANSITION TEMPERATURES OF QUENCH-CONDENSED CADMIUM AND ZINC FILMS. Granqvist, C. G.; Claeson, T. (Chalmers Univ. of Tech., Goteborg). J. Low Temp. Phys.; 10: No. 5-6, 735-750(Mar 1973).

The superconducting transition temperatures of Cd and Zn films deposited upon a liquid ^{3}He-cooled substrate increase compared to the bulk values. In disordered Cd, values of around 0.9 K are obtained, while corresponding T_c for Zn is about 1.4 K. These values agree well with theoretically predicted ones. For a $Cd_{0.9}Ge_{0.1}$, probably amorphous, film, T_c is further increased to about 1.6 K in approximate agreement with theory. The ratio between the energy gap and T_c, $2\Delta(0)/k_BT_c$, remains considerably lower than 3.53 in all the disordered films. This, as well as fairly broad transition ranges and the shape of the fluctuation pairing contribution to the conductance, is taken as an indication of structural inhomogeneities of the films. In pure, quench-condensed Mg films, no superconductivity is detected above 0.35 K. (auth)

3987 CALCULATIONS ON THE REVERSIBLE AND IRREVERSIBLE MAGNETIC BEHAVIOR OF LOW-KAPPA TYPE-II SUPERCONDUCTORS. Kes, P. H.; van der Klein, C. A. M.; de Klerk, D. (Univ., Leiden). J. Low Temp. Phys.; 10: No. 5-6, 759-779(Mar 1973).

A simple algebraic expression for the reversible magnetization curve in low-κ type-II superconductors is proposed. This model has been checked on the experimental results of very pure Nb and V, as measured by several authors. A quite good agreement is found for $T/T_c > 0.4$; for lower temperatures the agreement becomes worse, but this model still seems better than any other model known thus far from the literature. Using this relation together with a critical-state model it is possible to calculate the irreversible magnetization curves in increasing and decreasing fields between H_{c1} and H_{c2}. The results are compared with the experimental data obtained on a rectangular Nb sample. It turns out that Goedemoed's pinning model gives a good description. Also, a method is described to obtain the flux density gradient as a function of B directly from magnetization measurements. This provides a more sensitive method to compare the experiments with critical-state models. (auth)

3988 SECOND-VISCOSITY PHENOMENA IN DILUTE SOLUTIONS OF ^{3}He IN SUPERFLUID ^{4}He. Yaniv, A.; Disatnik, Y. (Tel-Aviv Univ., Israel). J. Low Temp. Phys.; 10: No. 5-6, 793-803(Mar 1973).

A theory of second-viscosity phenomena in dilute solutions of ^{3}He in superfluid ^{4}He is presented. The theory considers only phonon and ^{3}He quasi-particle excitations and is therefore valid at temperatures below about 0.6 K. It is shown, by an exact calculation, that within the framework of the Landau–Pomeranchuck model for the ^{3}He quasi-particle excitation energy, the four second-viscosity coefficients are related to one another and that only one of them is actually an independent kinetic coefficient. The relations between the second-viscosity coefficients are applied to analyze the expressions for the dissipative function and the first- and the second-sound attenuation coefficients. It is shown that the second-viscosity contribution to the second-sound attenuation is smaller by an order of magnitude than its contribution to the first-sound attenuation. (auth)

3989 SUPERCONDUCTIVITY IN AMORPHOUS Bi AND Ga. Vashishta, P. (Argonne National Lab., IL); Carbotte, J. P. J. Low Temp. Phys.; 10: No. 5-6, 551-571(Mar 1973).

The electron–phonon $\alpha^2(\omega)F(\omega)$ has been measured by Chen et al. in films of amorphous Bi and Ga. This was accomplished by inversion of low-temperature quasi-particle tunneling data. From $\alpha^2(\omega)F(\omega)$, the phonon renormalization of the electronic effective mass was calculated and was found to be considerably greater than it is in the case of the well-known strong-coupling superconductors Pb and Hg. These amorphous materials should, therefore, be ideal for a study of strong-coupling effects, i.e., deviations from BCS laws. Results are presented of a theoretical study of select thermodynamic properties of these materials based on numerical solutions, at finite temperatures, of the Eliashberg equations. (auth)

3990 SUPERCONDUCTIVITY IN THE HIGH-PRESSURE DHCP PHASE OF Pb–Bi. Jones, R. E. Jr.; Finnemore, D. K. (Ames Lab., IA). J. Low Temp. Phys.; 10: No. 5-6, 543-550 (Mar 1973).

The superconducting properties of a recently identified high-pressure dhcp phase of Pb–Bi were studied. There is a small abrupt drop in the superconducting transition temperature from 8.43 to 7.96 K as the samples transform from the mixed $\alpha-\beta$ phase to the dhcp phase. Both the mixed $\alpha-\beta$ phase and the dhcp phase show a surprisingly small negative slope for the volume dependence of the superconducting transition temperature corresponding to $d(\ln T_c)/d(\ln V) = 0.39$. (auth)

3991 CRITICAL TEMPERATURE OF SUPERCONDUCTING TRANSITION IN PLASTICALLY DEFORMED RHENIUM SINGLE CRYSTALS. Kopetskii, T. V.; Myshlyaev, M. M.; Novochatskaya, N. I.; Tulina, N. A.; Yukhanov, V. A. (Solid State Physics Inst., Chernogolovka, USSR). Phys. Status Solidi (a); 16: No. 1, 307-314(16 Mar 1973).

The effect of tensional plastic deformation and of defects produced during this process on the change in temperature (T_c) of the superconducting transition of Re single crystals was considered. The T_c dependence on the degree of plastic deformation was obtained for different deformation temperatures and crystal orientations. Electron microscopy shows that the defect structure of deformed Re is characterized by the presence of planar defects, i.e., a combination of slip bands and twin layers, between which single dislocations, dislocation arrays, loops, and dipoles are observed. Annealing and quenching experiments on deformed single crystals show that point defects and dislocations have a marked influence on the change in T_c while planar defects have an insignificant effect. 11 references. (auth)

3992 PARAMAGNETIC EFFECT IN SUPERCONDUCTORS OF THE FIRST KIND. Landau, I. L. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 2, 557-567(Feb 1973). (In Russian).

It is suggested that destruction of superconductivity by a current in the presence of a longitudinal magnetic field can be described by assuming a structure consisting of coaxial layers of a two-dimensional mixed state moving toward the sample axis. Results of an experimental study are presented which are in good agreement with the model proposed. (auth)

3993 FLUCTUATION SHIFT OF THE TRANSITION TEMPERATURE OF THIN SUPERCONDUCTING FILMS. Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fix.; 64: No. 2, 719-724(Feb 1973). (In Russian).

An expression for the superconducting transition temperature of thin films due to fluctuations of the order parameter Δ and electromagnetic field is derived. The effect of size quantization on T_c is considered. (auth)

3994 SPECIFIC HEAT OF TYPE II SUPERCONDUCTORS NEAR T_c. De Lange, O. L. (Clarkson Coll. of Tech., Potsdam, NY). Solid State Commun.; 12: No. 8, 771-772(15 Apr 1973).

An explanation is suggested for the anomaly that has been observed in the mixed to normal state specific heat discontinuity of type-II superconductors in low fields, near T_c. Comparison is made of the theoretical and experimental slopes of the specific heat jump at the upper critical field vs. reduced temperature, $t = T/T_c$, for $Nb_{80}Mo_{20}$. (UK)

3995 SPECIFIC HEAT OF THE (La, Gd) Al_2 SYSTEM IN THE SUPERCONDUCTING AND NORMAL STATE. Luengo,

C. A.; Maple, M. B. (Univ. of California, La Jolla). Solid State Commun.; 12: No. 8, 757-762(15 Apr 1973).

Specific heat measurements between 0.5 and 4.2°K are reported for the system (La, Gd) Al_2 in both the superconducting and normal state. The observed specific heat jump at the superconducting transition temperature T_c is in excellent agreement with the Abrikosov–Gor'kov(AG) theory. This is in accordance with the previously reported close correspondence of the T_c vs. Gd concentration curve with the AG theory. Two very interesting features occur in the normal state specific heat. First, the Gd impurities cause a suprisingly strong enhancement of the electronic specific heat coefficient. Second, there is a large magnetic field dependent Schottky-like anomaly at low temperatures. This anomaly persists even in the superconducting state. (auth)

3996 ANGULAR DEPENDENCE OF E–J CHARACTERISTICS OF THIN NbTi WIRES IN FLUX CREEP CONDITIONS. Hlasnik, I.; Krempasky, L.; Polak, M. (Electrotechnical Inst., Bratislava). Phys. Status Solidi (a); 16: No. 2, K153-K156(16 Apr 1973).

E–J (current density) characteristics of a simple superconducting NbTi wire was measured as a function of ϕ (angle between B and J) and B, and the dependence of the critical current density J_c on ϕ was also determined. ϕ was varied from 30 to 90°, and copper-stabilized NbTi wires were used. The slope of the log E vs. J lines is plotted vs. $B_\perp$ or B sin ϕ. The J_c vs. ϕ curve is close to the Hacq $\sin^{-2}\phi$ prediction and differs from that predicted by the isotropic Lorentz force model, indicating that the longitudinal field B cos ϕ contributes to the fluxoid pinning. The pinning force of NbTi wires is not isotropic but depends on ϕ as $\sin^{-1}\phi$. (DLC)

3997 FLUX JUMPS IN COMPOSITE SUPERCONDUCTORS IN A TIME DEPENDENT MAGNETIC FIELD. Kwasnitza, K. (Brown, Boveri and Co. Ltd., Zurich). Cryogenics; 13: No. 3, 169-174(Mar 1973).

Experimental investigations of the stability behavior of NbTi filamentary superconducting composites in a time-varying external magnetic field are reported. The magnetization due to the induced interfilamentary screening currents shows flux jumps. The influence of this sort of flux jump on dH/dt and on the twist rate has been measured, together with the influence exerted by the presence of a thin high-resistivity CuNi sheath surrounding the filaments. (auth)

3998 SURFACE SUPERCONDUCTIVITY IN LOW-κ Al–Ag ALLOYS. Nemoz, A.; Solecki, J. C. (Centre de Recherches sur Les Tres Basses Temperatures, Grenoble, France). Phys. Status Solidi (a); 16: No. 2, 641-646(16 Apr 1973).

The magnetization of superconducting Al–4 or 5 at.% Ag alloys with low κ_G ($0.40 < \kappa_G < 1.30$) are measured. The solid solutions are decomposed in silver-rich Guinier–Preston zones in a depleted matrix. During an isothermal aging, the residual resistivity ρ_0 and κ_G decrease continuously. Due to proximity effects in the volume, these alloys behave like homogeneous superconducting solid solutions, and because of the great coherence length and the low κ_G value, the effects of surface superconductivity are important. Some experimental results are presented on the variation of (H_{c3}/H_c, H_{c3}/H_{c2}) with κ_G, and on the magnetization of the superconducting surface sheath which agree with results issued from the G.L.A.G. theory. A qualitative explanation of the variation of the surface irreversibility, during the transition type II → type I, is given by the progressive disappearance of the superconducting sheath. (tr-auth)

3999 CRITICAL CURRENTS AND FLUX-CREEP IN A TYPE-II SUPERCONDUCTOR. Osborne, K. E.; Rose-Innes, A. C. (Univ. of Manchester, Eng.). Phil. Mag.; 27: No. 3, 683-688(Mar 1973).

The voltage-current characteristics of type-II superconductors in the mixed state (flux-flow curves) are normally curved at currents just above the critical current. Low-voltage measurements have been made, using a quantum interferometer, on a type-II superconductor in order to determine whether a critical current really exists or whether, if the sensitivity of the voltage-measuring instrument is increased indefinitely, the measured critical current approaches zero. It was found that there is a well-defined critical current greater than zero. The results indicate that the curvature of the characteristic is not normally due to thermally activated flux-creep as has often been suggested. (auth)

4000 POSSIBLE INFLUENCE OF THE QUASIPARTICLE-PAIR INTERFERENCE TERM ON THE CURRENT-VOLTAGE CHARACTERISTICS OF OXIDE BARRIER JOSEPHSON JUNCTIONS. Schlup, W. (IBM Research Lab., Zurich). Solid State Commun.; 12: No. 7, 631-634(1 Apr 1973).

The coefficients σ_0, σ_1 and j_1 of the current-phase relation of a planar oxide barrier Josephson junction are evaluated in the BCS theory as a function of voltage and gap energy. Since $\sigma_1/\sigma_0 \lessapprox -1$ for small voltages, and $\lessapprox 1$ above the gap voltage, σ_1 may have some observable consequence on the current-voltage characteristics. (auth)

4001 TERMINAL CHARACTERISTICS AND THERMAL STABILITY OF COMPOSITE SUPERCONDUCTING MATERIALS. Pt. 2. Sytchev, V. V.; Zenkevitch, V. B.; Altov, V. A., Kremlev, M. G.; Kulysov, N. A. (Inst. Vysekikh Temperature, Moscow). Cryogenics; 13: No. 1, 19-27(Jan 1973).

Terminal characteristics of composite conductors, when temperature varies over the conductor length, show a greater diversity of factors affecting thermal stability of the conductor than isothermal characteristics. Analyzing the experimental volt–ampere curves obtained, the effect of various mechanisms which frequently bring about noticeable deviations from theoretical idealized characteristics are discussed. (auth)

4002 TRANSPORT ENTROPY IN A DIRTY TRANSITION-METAL SUPERCONDUCTOR IN THE MIXED STATE. Tang, I. M. (American Univ., Beirut). Phys. Status Solidi (b); 56: No. 1, K47-K49(1 Mar 1973).

It is shown that a two-band analysis of the flux-flow properties of the dirty TM superconductors can explain the difference in the behaviors of the transport entropy in $Nb_{85}Mo_{15}$ and $Nb_{80}Mo_{20}$ alloys. It is noted that a disagreement in the analysis arises mainly from the low prediction of the mixed state thermal conductivity of the $Nb_{85}Mo_{15}$ superconductor in the one-band theory. One of the main effects of the second band on the thermal conductivity is an increase in its magnitude. Since everything else remains the same in the two-band analysis of the Ettingshausen effect, the increase in the magnitude of the thermal conductivity provided by the two-band theory will remove some of the ambiguity arising in the use of the measured thermal conductivity in the analysis of the experimental data. (JRI)

4003 PLASTICITY OF LEAD ALLOY SINGLE CRYSTALS IN THE SUPERCONDUCTING AND NORMAL STATES AT 4.2 K. Kostorz, G. (Institut Max von Laue-Paul Langevin, Grenoble, France). Phil. Mag.; 27: No. 3, 633-649(Mar 1973).

The flow stress increment $\Delta\tau_{SN}$ associated with a transition superconducting-normal has been studied for a number of lead-thallium, -tin, -bismuth, -cadmium single crystals at 4.2K as a function of solute concentration, deformation, and strain rate. Increasing solute concentrations cause an increase of $\Delta\tau_{SN}$ at the beginning of the deformation, and the stress dependence of $\Delta\tau_{SN}$ is also strongly affected by solute atoms. At small solute concentrations, $\Delta\tau_{SN}$ was found to increase along the deformation curve in a similar way as in pure lead. At higher solute concentrations $\Delta\tau_{SN}$ decreases as the applied stress increases. The dislocation inertial model recently proposed by Granato (Granato, A. V. Phys. Rev. Lett., 1971, 27, 660; Phys. Rev. B., 1971, 4, 2196) for the enhanced plasticity of the superconducting state is discussed with respect to solid solution effects. If it is assumed that electronic drag remains the predominant dissipative mechanism for alloys, the model can explain all the observed effects at least qualitatively. (auth)

4004 TRANSFER CHARACTERISTICS OF PHONON COUPLED SUPERCONDUCTING TUNNEL JUNCTIONS. Long, A. R.; Adkins, C. J. (Cambridge Univ., Eng.). Phil. Mag.; 27: No. 4, 865-882(Apr 1973).

Results of theoretical and experimental investigations of the form of the transfer characteristics of phonon-coupled superconducting tunnel junctions are presented. In the "linear" regime when quasiparticle densities are little deviated from their thermal values, the only outstanding feature is a gradient discontinuity which occurs when the generator voltage is large enough for quasiparticle relaxation processes to contribute to the density of detectable phonons. A fundamental theoretical treatment for this case gives an adequate qualitative description of observed structure and quantitative differences are tentatively attributed to inelastic scattering. Results in the "overinjection" regime are much more complex. Some of the processes which may be expected to modify the spectrum of generated phonons and the detector response are discussed, and are shown to account qualitatively for the various features of the characteristics observed. (auth)

4005 MAGNETIC FLUX PINNING IN A SUPERCONDUCTOR OF THE FIRST KIND IN THE INTERMEDIATE STATE. Kano, L. M.; Shukhman, V. A. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 3, 890-900(Mar 1973). (In Russian).

A study is made of the conditions under which a transport current can flow without loss in a Type-I superconductor in the intermediate state. It is found that in a comparatively broad range of field strengths in the intermediate state the critical current does not vanish. The results are interpreted from the viewpoint

of pinning of the magnetic flux. The dependence of the mean pinning force on sample geometry and thermal treatment of the samples is discussed. It is pointed out that superconductors of the first kind in the intermediate state may be convenient for carrying out an experimental study of pinning mechanisms. (auth)

4006 RADIO-FREQUENCY SIZE EFFECT IN THE LAYER OF A NORMAL METAL BORDERING WITH THE SUPERCONDUCTING PHASE. Krylov, I. P.; Sharvin, Yu. V. (Inst. of Physical Problems, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 3, 946-957(Mar 1973). (In Russian).

The radio-frequency size effect (RSE) is investigated in the layer of a normal metal bordered by vacuum and by the superconducting phase. It is shown experimentally that the excitations are reflected from the boundary between the phases in such a way that momentum is conserved and the signs of the velocity vector, charge and mass are altered, this being in accordance with the Andreyev theory. A confirmation of this is not only the fact that the first order RSE lines are observed at a normal layer thickness equal to half the diameter of the extreme trajectories, but also by the shape of the second order RSE lines. The latter differ from the shapes of lines in a normal metal plate only with respect to sign of the signal. By varying the thickness of the normal metal layer it was possible to measure the electron mean free path for various extreme cross sections. (auth)

4007 SUPERCONDUCTIVITY AND ELECTRON STRUCTURE OF A SOLID SOLUTION OF TITANIUM IN NIOBIUM. Shchetkin, I. S.; Kharchenko, T. N. (Physical-Technical Inst. of Low Temperatures, Kharkov). Zh. Eksp. Teor. Fiz.; 64: No. 3, 964-969 (Mar 1973). (In Russian).

Extensive information on the electron and superconducting characteristic of a solid Nb + 7.23 at. % Ti is obtained by measuring the temperature dependence of the specific heat in the temperature range from 2.5 to 18°K. The alloy is found to be a superconductor with strong electron–phonon interaction. This is confirmed by the magnitude of the specific heat discontinuity and by the temperature behavior of the thermodynamic critical magnetic field. An anomalous behavior of the low-temperature specific heat is observed which can be satisfactorily described by the theory of superconductivity which takes into account overlapping of energy bands. The main parameters of the bands were obtained by treating the experimental data in the two-band model. It is pointed out that the alloy studied is an interesting case when the bond in one band (d-band) is a weak one of the BCS type and the other is a strong one. The applicability of the Anderson criterion to two-band superconductors, when formulated for one-band anisotropic superconductors, is discussed. (auth)

4008 RESISTANCE OF SUPERCONDUCTORS NEAR THE CRITICAL FIELD STRENGTH H_{c2}. Larkin, A. I.; Ovchinnikov, Yu. N. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 3, 1096-1104(Mar 1973). (In Russian).

It is shown that near the superconducting transition temperature the conductivity depends nonlinearly on the magnetic field strength and may considerably exceed that of a normal metal in fields near to the critical value. Several regions exist with significantly different dependence of the conductivity on magnetic impurity concentration, temperature and magnetic field strength. (auth)

4009 SPECIFIC HEAT STUDIES OF SUPERCONDUCTING Pb–Bi–Tl AND Hg–In ALLOYS FROM 0.5 TO 9K. Cluxton, D. H. Kent, OH; Kent State Univ. (1972). 209p. University Microfilms Order No. 73-6616.

Thesis (Ph. D.).

The specific heat of $Pb_{.90}Bi_{.10}$, $Pb_{.90}Tl_{.10}$, and the isoelectronic alloy $Pb_{.90}Bi_{.05}Tl_{.05}$ was measured to better than 1%, as well as that of two Hg–In alloys. Specific heat data were acquired in both the normal and superconducting states, and hand and computer fits made to determine the parameters γ, θ_D, T_c, H_o, $H_c(T)$, and $(C_n - C_s)/T_c$ as a function of impurity concentration. T_c is analyzed in detail and compared to McMillan's equation. It is verified that $\langle\omega\rangle$ is a better "typical" phonon frequency than θ_D, and that Dynes' form of McMillan's equation fits the lead alloy data quite well using values of $\langle\omega\rangle$ and λ from tunneling data. T_c increases with increasing electron–phonon coupling strength. Coupling strength in turn increases with electron per atom ratio z, and a value of $d\ln T_c/d\ln z = 1.78$ is measured for the lead alloys. The critical magnetic field $H_c(T)$ is calculated from specific heat data and plotted as deviation from parabolic temperature dependence. The strong coupling metals Pb and Hg have positive deviations, as do the alloys measured here, and an increasing height of the deviations with coupling strength is noted, although not totally confirmed. The curves for the two Hg–In alloys are nearly the same and show a smaller deivation than Hg. The zero-temperature critical field H_o are determined to within 2%, and they too are found to increase with increasing electron-per-atom ratio in the lead alloys, but with a cusp at pure Pb like the one in the electronic specific heat γ. When the BCS prediction of H_o is compared with the measured values for the lead alloys, the measured values are found to be lower, the discrepancy increasing with coupling strength. This result agrees with strong coupling theory, but exact calculations of the correction term require better tunneling data than is now available on these alloys. Also, the specific heat jump at T_c is found to increase with coupling strength, although the values are somewhat uncertain. The Hg–In specific heat data yield values of $\gamma = 1.57$ and 1.40 mj/moleK^2, $\theta_D = 93.4$ and 94.5°K, $T_c = 3.56$ and 3.42°K, and $H_o = 308$ ahd 287 gauss for $Hg_{.885}In_{.115}$ and $Hg_{.86}In_{.14}$, respectively. In the process of measuring the molar volume of Hg–In alloys, a sharp drop of 1% in V_m within 0.25% In concentration at 11% In in Hg was discovered. The entire range from pure Hg to 18% In in Hg was investigated by a careful bulk density measurement in cold alcohol reproducible to ±0.1% even after annealing. A steady increase in V_m with increasing In content is observed up to the sharp drop at 11%, followed by a somewhat slower increase. This result conflicts with other x-ray data on this system, but the discontinuity at 11% is at the same place that a sharp drop in T_c has been seen by Merriam et al., and tentatively explained in terms of a Fermi surface-Brillouin zone interaction. (DLC)

4010 RELATIONSHIP BETWEEN STRUCTURE AND CRITICAL CURRENT DENSITY IN SUPERCONDUCTING TITANIUM–NIOBIUM ALLOYS WITH ADDITIONS OF NEUTRAL ELEMENTS. Rassmann, G.; Ilgen, L. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Neue Huette; 17: No. 12, 718-723(Dec 1972). (In German).

Ternary additions of zirconium, tin, germanium, and boron were studied with regard to their effect on the critical current density (4.2°K, mean field strength around 50 kOe) of superconducting titanium–niobium alloys. All of these neutral additions raised the critical current density. In the system Ti–Nb–Zr, the optimal composition lay on a straight line that intersected the Ti–Nb projection at 22.5 at. % Nb, i.e., at the boundary concentration in the binary system for the suppression of the martensitic transition. (tr-auth)

4011 LIQUID HELIUM-3: A NEW SUPERFLUID SUGGESTED. Metz, W. D. Science; 180: No. 4087, 725-726(18 May 1973).

Recent research results on liquid helium-3 that suggest the possibility of its superfluidity are described and discussed. (MHR)

Equipment and Devices

Refer also to abstract 4956.

4012 (COO-3311-11) FORMING OF COMPOSITE FOR SUPERCONDUCTING ROD. Technical Progress Report. Hahn, W. C. Jr. (Lehigh Univ., Bethlehem, Pa. Dept. of Metallurgy and Materials Science). 5 Mar 1973. Contract AT(11-1)-3311. 4p. Dep. NTIS $3.00.

Progress in fabrication of a composite wire made of multifilaments of a relatively hard metal in a matrix of a soft metal is summarized briefly. Publications during the period supported are listed. (MHR)

4013 (LBL–1108) EVALUATION OF OPTIMAL PROCESS PARAMETERS FOR THE PRODUCTION OF SUPERCONDUCTING NIOBIUM–TIN TAPE IN RELATION TO PILOT PLANT DESIGN. Hemachalam, K. (California Univ., Berkeley. Lawrence Berkeley Lab.). June 1972. Contract W-7405-eng-48. 51p. Dep. NTIS $4.75.

Superconducting niobium–tin composites containing filamentary Nb_3Sn were fabricated by powder metallurgy technique which involved powder rolling, sintering, infiltration, mechanical reduction and diffusion heat treatment. The influence of various process parameters at each step was experimentally examined. Optimal values were recommended to be incorporated in a pilot plant for continuous production of the composite. Potential problems in the design and operation have been discussed and possible solutions presented. Finally, areas requiring additional investigation are indicated. (auth)

4014 (ORNL-TM–4198) CALCULATION OF RADIAL MAGNETIC FIELDS FOR AXISYMMETRIC SOLENOIDS WITH RECTANGULAR CROSS SECTION. Walstrom, P. L.; Lubell, M. S. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 19p. Dep. NTIS $3.00.

The ratio of maximum radial field to maximum axial field has been calculated numerically for axisymmetric solenoids of rectangular cross section and constant current density over a wide range of coil configurations. It is also shown that for a certain range of coil shapes the maximum modulus of the magnetic field

occurs on the end faces of the windings. These considerations are pertinent in the design of superconducting magnets for two reasons: many superconductors have lower critical current in a field normal to the wide surface than in a field parallel to the surface and large radial fields can cause catastrophic flux jumps. (auth)

4015 PORTABLE HELIUM DEWARS FOR USE WITH SUPERCONDUCTING MAGNETOMETERS. Zimmerman, J. E.; Siegwarth, J. D. (National Bureau of Standards, Boulder, CO). Cryogenics; 13: No. 3, 158-159(Mar 1973).

Simple helium dewars have been constructed using gas-cooled radiation shields and multilayer aluminized plastic insulation. They will retain one litre of liquid for up to 40 hours. The shields may be made mostly nonconducting so the dewar can be used with ultrasensitive superconducting magnetometers. For most other applications thin sheet metal such as copper or aluminium is suitable for the shields. (auth)

4016 ULTRALOW TEMPERATURES: HOW AND WHY. Huiskamp, W. J.; Lounasmaa, O. V. (Kamerlingh Onnes Laboratorium, Leiden). Rep. Progr. Phys.; 36: No. 4, 423-496(1973).

Three relatively new methods which are capable of producing temperatures in the milli- or microkelvin region, that is, dilution refrigeration, Pomeranchuk cooling, and several variations of nuclear demagnetization, are first discussed in some detail. The application of ultralow temperature techniques to many fields of physics and some of the most fundamental results thereby obtained are then reviewed briefly. In particular, Fermi liquids, dilute magnetic alloys, superconductivity, magnetic cooperative phenomena, nuclear structure, elementary particle scattering and astrophysical applications are discussed. (auth)

4017 MILLIMETER AND SUBMILLIMETER WAVE DETECTION AND MIXING WITH SUPERCONDUCTING WEAK LINKS. Richards, P. L.; Auracher, F.; Van Duzer, T. (Univ. of California, Berkeley). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 1, 36-45(Jan 1973).

A weak link between two bulk superconductors can exhibit Josephson effects and can be used as a fast sensitive detector or mixer for electromagnetic radiation. Emphasis is placed on the millimeter and submillimeter range where such applications are potentially most important, though such devices should also work well at lower frequencies. The peculiar properties of the weak link make possible a variety of modes of operation including one in which it is both local oscillator and mixer. These modes of operation are analyzed and the pivotal experiments are reviewed. Noise and impedance matching are considered and comparison is made with other types of detectors of millimeter and submillimeter waves. (auth)

4018 SYNCHRONOUS ALTERNATING CURRENT ELECTRICAL MACHINES. Hughes, A. (To International Research and Development Co. Ltd.). British Patent 1,302,549. 10 Jan 1973. Filed date 20 Aug 1969. 5p.

Reference is made to machines having a dc excited rotor field winding of superconducting material and a stator armature winding of non-superconducting material. The use of a superconducting field winding eliminates the need for a stator core of magnetic material, and the stator winding conductors may be supported in air or in a casing of non-magnetic material such as an epoxy resin. Because of the high magnetic field intensities produced, however, it is necessary to have a magnetic shield surrounding the rotor, but this is usually spaced well away from the rotor so as to lie outside the areas of high flux density. Large machines of this kind can cause problems under short circuit conditions as the currents flowing may severely damage the windings. In the machine described the stator winding has conductors supported in a nonmagnetic environment adjacent the rotor, and reactance conductors are located in a magnetic shield surrounding the stator conductors and the rotor, together with end connections connecting the stator and reactance conductors in series. The reactance conductors, associated with the material of the magnetic shield, provide sufficient reactance to limit short circuit currents without the necessity of providing any additional magnetic material around the stator windings. (UK)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 3190, 3327, 3415, 4399, 4400, 4402, 4405, and 4406.

4019 (CONF-721018-18) DISCRETE ORDINATES-NUMERICAL INTEGRATION METHOD FOR NEUTRON TRANSPORT EQUATION IN ONE AND TWO DIMENSIONAL GEOMETRIES. Takeuchi, K.; Yamaji, A. 1972. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A numerical approach to the Boltzmann transport equation is presented for practical calculations of the neutron penetration. The scattering integral is numerically evaluated, an anisotropic treatment being used for elastic scattering and an isotropic treatment being used for inelastic scattering. A system of coupled one-group integral equations, converted from the energy-dependent transport equation, is calculated by a line integration along the neutron flight path. The results were compared with the experimental angular spectra in graphite and water, and with experimental reaction rates in iron-water. (France)

4020 (EIR-232) NEW SPATIAL DIFFERENCING FOR THE NEUTRON TRANSPORT EQUATION. Arkuszewski, J. J. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Feb. 1973. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

An attempt is made to construct a working difference scheme based on the BEM concept (1972) using the discrete ordinates approach. It is shown that besides considerable difficulties with computer implementation, the new technique gives rise to very strong ray effects and fails to satisfy rigorously the neutron conservation law for homogeneous boundary conditions. For these reasons this concept was abandoned. Consideration is given to the development of the discrete ordinates integrated technique (DOIT), where the discrete ordinates are used for angular quadratures only, while the spatial approximation of the streaming operator is performed for a continuous set of μ and η within some predefined angular domains. This method, although not removing completely the ray effects, has been found to be quite promising and has been incorporated into a new two-dimensional (x,y) geometry transport program DOIT. Extensive numerical tests of DOIT are given and compared with results obtained by the code DOT, which employs the traditional diamond difference scheme. Conclusions indicate the superiority of DOIT. (WDM)

4021 (FEI-323) NEUTRON THERMALIZATION IN BeO AND Be SYSTEMS OF FINITE SIZE. Kuznetsov, V. A.; Bankrashkova, M. Ya.; Bogomolov, V. N.; Bulavin, P. E.; Dekusar, V. M.; Ilyasova G. A.; Somov, I. E.; Chernov, L. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1972. 26p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The three-dimensional energy distribution of neutrons in nonbreeder assemblies of moderators of finite dimensions was investigated. Neutron leakage was assumed to play an important role in the formation of the neutron spectra. Be and BeO were employed as moderators, and steel or Al_2O_3 constituted absorbing elements. Spectral measurements of vector and scalar neutron fluxes were conducted by the time-of-flight method using a pulsed neutron source. Not only a spatial but also a thermal dependence of the neutron spectra was studied with the BeO assembly. Neutron spectra were calculated in the P_1 approximation using the spherical harmonics method. Zeroth and first angular moments of the characteristic scattering curve for BeO were calculated according to the gaseous model, and for Be, according to the crystal model. The neutron spectra measured were compared with those calculated, with satisfactory agreement. (13 figures, 4 tables) (tr-auth)

4022 (ORNL-TM-4216) IS THERE STILL A NITROGEN CROSS SECTION DISCREPANCY? Perey, F. G.; Dickens, J. K. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 12p. Dep. NTIS $3.00.

For several years there have been great uncertainties as to which nitrogen neutron cross-section set should be used for neutron transport of 14-MeV neutrons in air. Various discrepancies were found between microscopic cross-section measurements and difficulties experienced in calculating correctly results of integral experiments. Most neutron air transport calculations have been performed using either the nitrogen cross-section set of Straker (1969) or the Young-Foster (1970) set. These two cross-section sets differ by about a factor of two in gamma-ray production cross sections around 14 MeV. In this note the status of these evaluated cross-section sets is reviewed on the basis of recent work; and it is concluded that the Young-Foster evaluation, MAT 4133 Mod 2, is more nearly consistent with all the available information and should be preferred over the Straker set. (auth)

4023 (UCID-16245) EXISTENCE AND UNIQUENESS OF SOLUTIONS FOR THE WEIGHTED CENTRAL DIFFERENCE APPROXIMATIONS FOR THE NEUTRON TRANSPORT EQUATION. Madsen, N. K. (California Univ., Livermore. Lawrence Livermore Lab.). Mar 1973. Contract W-7405-eng-48. 15p. Dep. NTIS $3.00.

Existence and uniqueness of solutions for some of the weighted central difference (WCD) approximations are established. The WCD equations approximate the discrete ordinate equations, which in turn are an approximation of the linear Boltzmann or neutron transport equation. (auth)

4024 EXACT TIME-DEPENDENT SECOND SPATIAL MOMENT OF THE ONE-SPEED NEUTRON TRANSPORT MODEL. Barnett, C. S. (Univ. of California, Livermore). Nucl. Sci. Eng.; 50: No. 4, 398-401(Apr 1973).

One-speed model neutron migration in an infinite homogeneous medium is considered. A probabilistic argument is used to derive an expression for the neutron's mean square distance from the origin at time t, given that absorption has not occurred. For large t, the exact result tends to the diffusion theory result, while for small t, the exact result tends to $(vt)^2$, an extreme nondiffusion result. (auth)

4025 NEUTRON THERMALIZATION IN VARIOUS H_2O-D_2O MIXTURES IN THE TEMPERATURE RANGE 253 to 4°K. Gangwani, G. S. (Dyal Singh Coll., New Delhi); Tewari, S. P.; Kothari, L. S. Nucl. Sci. Eng.; 50: No. 4, 337-344(Apr 1973).

A theoretical study of the pulsed neutron problem and of steady-state neutron spectra has been made in mixtures of H_2O and D_2O in the temperature range 253 to 4°K. Mixtures with D_2O content of 0, 5, 10, 15, and 20 wt% have been considered. For the pulsed neutron problem the multigroup Boltzmann equation in the diffusion approximation has been diagonalized to obtain asymptotic and transient spectra in assemblies with buckling values ranging from 0 to 0.6 cm^{-2} at 253, 77, and 21°K. The calculated values of the fundamental mode decay constant in various assemblies of ice at 253°K containing 20% D_2O are found to agree very well with the experimental values reported by Salaita. For the steady-state problem, the multigroup inhomogeneous Boltzmann equation in the diffusion approximation has been solved by the matrix inversion method for different mixtures at 253, 77, 21, and 4°K. It is shown that there is an enhancement of cold neutron flux as the D_2O content in ice is gradually increased. As in the case of H_2O ice, it is found that the mean energy of the neutron distribution goes on decreasing with decrease in ice temperature only as long as the temperature is above about 20°K. No further reduction in the mean energy of the neutron distribution is obtained when the temperature of the mixture is reduced below 21°K. It is shown that at 21°K, ice containing about 10 to 20% D_2O is a better cold neutron source than pure H_2O ice. (auth)

4026 INTERPOLATION FORMULA OF THERMAL NEUTRON SCATTERING LAW IN TEMPERATURE INTERVAL. Nakahara, Y. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 12, 743-748(Dec 1972).

A very useful formula for interpolating the thermal neutron scattering law in temperature intervals is derived by separating the scattering law into two factors, strongly and weakly dependent on temperature. The strong temperature dependence of the scattering law is characterized by Debye-Waller factors, which are found to increase almost linearly with temperature for most moderators. The Debye-Waller factor is approximated by a linear function of temperature with the proportional constant determined so as to give the exact scattering laws at the boundaries of the temperature interval. The formula is applied to two typical moderators (graphite and light water) to demonstrate its effectiveness and accuracy. It is shown that interpolated values of the scattering law are accurate within experimental errors in the practical range of neutron momentum and energy transfers. (4 figures, 3 tables) (auth)

4027 RELAXATION TIMES IN DECAY OF ANISOTROPIC SCATTERED NEUTRON PULSES. Caprini, I.; Protopopescu, V. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 5, 637-641(1972).

Several dispersion laws for different anisotropies are represented in the physical domain for the scattering of neutron pulses:

it can be shown that, for anisotropies greater than a specified value, the dispersion law exhibits a loop for the case of the one-speed Boltzmann equation. This feature suggests the possibility of complex decay constants or complex bucklings in the decay of neutron pulses. Whether this property also persists in the more realistic case of energy-dependent anisotropic scattering is discussed; and it is concluded, on the basis of some simple kernels, that the complex relaxation times are not a general feature of anisotropic models. It is also found that the presence of an energy dependence favors an increase of the maximum critical buckling beyond which no more real eigenvalues exist; i.e., it acts in a manner opposite to that exhibited when the system size is decreased. (3 figures) (RWR)

4028 CALCULATION OF NEUTRON SLOWING DOWN SPECTRUM IN WATER USING GREEN'S FUNCTION. Bhatti, R. A. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). J. Nucl. Energy; 27: No. 4, 247-262(Apr 1973).

A method is presented which provides an analytical solution to the steady-state, energy-dependent neutron transport equation for the hydrogen mixture case with isotropic elastic and inelastic scattering. The main characteristics of the method are the use of Green's function and diffusion approximation. A difference form of the Boltzmann equation is derived as the final expression for machine computation. The neutron slowing down spectrum is calculated from a $^{3}T(d, n)^{4}He$ source put at the center of a cubical block of water. A comparison is made with the slowing down spectrum calculated from a $^{241}Am-^{9}Be$ source. The effects of using different models for inelastic scattering by the oxygen atom in the water molecule on the slowing down spectrum are also investigated. Some thermal group cross-sections are developed, and the thermal spectrum in water is calculated for stationary nuclei and is compared with experiments. Agreement between them is good, considering the approximations made in the calculations and the difficulties involved in measuring the thermal spectrum in water. (auth)

4029 CORRECTION FOR HIGHER-ORDER SCATTERING ANISOTROPY IN NEUTRON TRANSPORT THEORY. Stacey, W. M. (Argonne National Lab., IL). J. Nucl. Energy; 27: No. 4, 263-272(Apr 1973).

A method is presented for correcting integral parameters to account for the effect of higher-order scattering anisotropy when the neutron flux used in evaluating the parameters is based upon a transport calculation with a low-order scattering approximation. The method is based upon a variational principle for the parameter of interest. (auth)

4030 LEKTSII PO TEORII PERENOSA NEITRONOV. (Lectures on Neutron Transport Theory). Smelov, V. V. Moscow; Atomizdat (1972). 176p.

An introduction to the theory of an important class of equations in modern physics—transport theory—is offered. An attempt is made to present neutron transport theory in the most readily intelligible manner and, at the same time, preserve a judicious rigorousness. Single-velocity theory, followed by theory which accounts for energy dependence, and the statement of problems in both rigorous and approximate formulations are considered. Scattering functions in a model of elastic neutron–nucleus collisions, neutron moderation in homogeneous media, and excitation theory are elucidated. The spherical harmonics method, the mathematical technique of "splitting," and neutron thermalization are treated in three appendices. (31 figures, 33 references) (KSW)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 3951, 4049, 4061, 4232, 4259, 4274, and 4420.

4031 (ITF-72-109-P) CALCULATION OF CROSS-SECTION OF THE REACTION $^{3}He(e,e'p)^{2}H$ BY THE K-HARMONIC METHOD. Comparison With Other Calculations. Tartakovskii, V. K.; Kozlovskii, I. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The differential cross section of the two-particle electrodisintegration of ^{3}He is calculated for the case when a scattered electron and a produced proton are detected in coincidence. The wave functions of ^{3}He used are obtained by the K-harmonics method for a square-well potential for the two-particle interaction. The calculated dependence of the cross section on proton emission angle agrees better with the experimental one than in the case of the wave functions used for a separable interaction and model functions such as the Gaussian functions. The states of mixed symmetry in the wave function of ^{3}He, when taken into account, improve agreement with experiment. The scattered electron angular distributions are obtained by means of the wave functions calculated by the K-harmonics method and by means the Gaussian functions; the results are compared with experimental data. The influence of the choice of the wave functions of ^{3}He and ^{2}H is discussed, as well as the influence of the asymptotic behavior of the wave function of ^{3}He on the cross sections under consideration. (7 figures) (auth)

4032 (LBL–1347) DOUBLE-CHARGE-EXCHANGE AND INELASTIC SCATTERING IN $\pi^- + {}^{3}He$. Sperinde, J. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). 4 Aug 1971. Contract W-7405-eng-48. 97p. Dep. NTIS $7.00.

Thesis.

The reactions $\pi^- + {}^{3}He \rightarrow \pi^+ + 3n$ and $\pi^- + {}^{3}He \rightarrow \pi^- + {}^{3}He^*$ were studied to investigate the $T = 3/2$ three nucleon system. The differential cross sections were measured at 140 MeV incident pion energy for a scattering angle of about 30 deg. The secondary pion was momentum analyzed in a magnetostrictive-readout wire-chamber spectrometer. The double-charge-exchange reaction yielded a secondary pion energy distribution which can be explained either as a $T = 3/2$ three-nucleon resonance or as a consequence of the low relative momenta of the nucleons in the ^{3}He nucleus. No evidence of the effects observed in the double-charge-exchange reaction was seen in the inelastic scattering reaction. This was probably due to the proximity to the bound state of ^{3}He. (auth)

4033 (ORO-4317-19) N–D BACKWARD SCATTERING AND VIRTUAL STATES OF THE TRINUCLEON. Technical report No. 73-109. Brady, T. J. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Apr 1973. Contract AT(40-1)-4317. 8p. Dep. NTIS $3.00.

The 180° nucleon–deuteron elastic cross section exhibits a peak as a function of nucleon energy which has been interpreted as due to a virtual state of the trinucleon. This interpretation is examined within the context of the Amado model. (auth) (2 figures)

4034 SPIN-EFFECTS IN THEORY OF p ^{4}He SCATTERING. Lykasov, G. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 2, 301-308(Feb 1973). (In Russian).

The role of NN amplitude spin structure in elastic p ^{4}He scattering is studied at $T_p = 600$ MeV in the Glauber approximation. It is shown, that account for amplitude spin dependence of NN scattering changes greatly the value of differential cross section for the considered process in the range of large transferred momenta. At large momentum transfer polarization effects turn out to be very sensitive for the choice of the wave function of ^{4}He ground state. (auth)

4035 CALCULATION OF CROSS SECTION FOR THE REACTION $^{3}He(e,e'p)^{2}H$ BY THE K-HARMONIC METHOD. Comparison with Other Calculations. Tartakovskii, V. K.; Kozlovskii, I. V. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 17: No. 2, 278-288(Feb 1973).

The differential cross section of the two-particle electrodisintegration of ^{3}He is calculated in the case when scattered electron and produced proton are detected in coincidence. The wave functions of ^{3}He, obtained by the K-harmonic method for a square-well potential of two-particle interaction, were used. The calculated dependence of cross section on proton escape angle is in a better agreement with experimental one than in the case of the wave functions used for separable interaction and model functions such as the Gaussian functions. Account for the states of mixed symmetry in the wave function of ^{3}He improves agreement with experiment. The scattered electron angular distributions are obtained by means of the wave functions calculated by the K-harmonic method and by means of the Gaussian functions; the results are compared with experimental data. The influence of choice of the wave functions of ^{3}He and ^{2}H is discussed as well as the influence of asymptotic behavior of the wave function of ^{3}He on the cross sections under consideration. (auth)

4036 NEUTRON POLARIZATION IN NUCLEAR μ^--CAPTURE. Salganik, Yu. A.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 2, 267-270(Feb 1973). (In Russian).

The degree of neutron polarization caused by capturing μ^- mesons by nuclei is considered after the example of ^{4}He $(\mu^-, \nu n)$ ^{3}H reaction. It is shown, that the degree of polarization as well as asymmetry are greatly determined by relativistic (proportional to p/M) terms of effective muon-nucleon Hamiltonian. The influence of the interaction in the final state between neutron and residual nucleus as well as the influence of short-range nucleon–nucleon

correlations on the indicated characteristics of the process are studied. (auth)

4037 DISTRIBUTION OF SUBSTANCE IN NUCLEI. Aver'yanov, I. K.; Sadovoi, A. A.; Chulkov, N. M.; Vakhlamova, L. L. Yadern. Fiz.; 17: No. 2, 258-261(Feb 1973). (In Russian).

The results of numerical calculations of substance distribution of the basic states of ^{4}He, ^{16}O, ^{40}Ca nuclei, carried out in K_{min} approximation with hyperspherical function method, are considered. The sensitivity of such calculations for the used local nucleon–nucleon potentials is singled out. The calculations point to the fact, that substance distribution of the basic states of ^{16}O and ^{40}Ca nuclei has approximately the same maximum value. In the vicinity of the nucleus center there is a plateau onto which a peculiar fine structure is imposed. A contribution of different nucleon states to the substance distribution in ^{16}O and ^{40}Ca nuclei is considered. (auth)

4038 POLARIZATION OF NEUTRONS FROM THE ^{2}H(d,n)^{3}He REACTION FOR DEUTERON ENERGIES LESS THAN 1 MeV. Davie, H.; Galloway, R. B. (Univ. of Edinburgh). Nucl. Instrum. Methods; 108: No. 3, 581-586(1973).

A series of measurements are reported of the polarization of neutrons emitted at a laboratory reaction angle of 46° from the ^{2}H(d,n)^{3}He reaction for deuterons from 0.3 to 0.9 MeV incident on a thin target. Particular attention is given to the collection and analysis of data from the ^{4}He scattering polarimeter in a way which detects and corrects for spurious scattering effects, so as to give confidence that the polarization values reported correctly chart the energy dependence through the scatter of previously published discrepant values. A possible origin of past discrepancies is discussed. (4 figures, 1 table) (auth)

4039 ELECTRODISINTEGRATION OF THE DEUTERON. Skopik, D. M.; Shin, Y. M.; Tomusiak, E. L.; Phenneger, M. C.; Chong, K. F. (Univ. of Saskatchewan, Saskatoon). Phys. Lett. 43B: No. 6, 481-482(19 Mar 1973).

The energy and angular distribution of the electrodisintegration protons from deuterium were measured. A theoretical comparison with the data is also presented. (auth)

4040 ENERGY LEVELS OF LIGHT NUCLEI A = 4. Fiarman, S.; Meyerhof, W. E. (Stanford Univ., CA). Nucl. Phys. A206: No. 1, 1-64(1973).

A compilation of energy levels for A = 4 nuclei is presented with emphasis on material leading to information about the structure of the A = 4 systems. Several unbound excited states of ^{4}He have been firmly established, such as the T = 0, $J^\pi = 0^+, 0^-, 2^-$ states all near 20 MeV excitation energy and the T = 1, $J^\pi = 2^-$ state in ^{4}H, ^{4}He, ^{4}Li at ≈26 MeV excitation in ^{4}He. Other T = 1 and T = 0 states in the 20 to 35 MeV range of excitation in ^{4}He have been proposed to fit existing data, and all but one at 25.5 MeV are expected from shell-model calculations. (4 figures, 19 tables, 637 references) (auth)

4041 OFF-SHELL EFFECTS IN THE THREE-NUCLEON BOUND STATE. Afnan, I. R. (Flinders Univ. of South Australia, Bedford Park); Serduke, F. J. D. Phys. Lett.; 44B: No. 2, 143-146(16 Apr 1973).

Phase-shift-equivalent separable potentials are used to study the sensitivity of the triton binding energy E_T to the off-shell behavior of the two-nucleon T matrix. It is found that the deuteron wave function significantly constrains the theoretical uncertainty in E_T and that the properties of the off-shell T matrix at intermediate energies are only weakly reflected in E_T. (auth)

4042 PROTON–NEUTRON FINAL-STATE INTERACTION IN THE REACTION ^{1}H(d,2p)n AT 12.6 MeV. Thijs, G. D.; Schram, P. H.; Jonker, C. C. (Vrije Univ., Amsterdam). Nucl. Phys.; A205: No. 2, 413-432(1973).

Two-dimensional coincidence spectra of protons from the reaction p + d → p + p + n were measured at a deuteron bombarding energy of 12.6 MeV. The detection angles were selected to favor the (np) final-state interaction (FSI). The regions of the spectra that contain the (np) FSI peak were analyzed with the impulse approximation (IA), taking into account spin dependence and antisymmetrization of wave functions. In addition, a modified impulse approximation (MIA) was used to account for the dominant (np) FSI in higher order. To correct for experimental broadening effects the data were simulated with a Monte Carlo program on the basis of the IA, the MIA or a Watson model, that accounts only for the dominant singlet (np) FSI. The comparative analysis of the results shows that the MIA can correct to some extent the predictions of the Watson model for the presence of competing FSI and spectator effects. (auth)

4043 $\frac{1}{2}^+$ STATE OF ^{3}H AND ^{3}He BELOW THE BREAK-UP THRESHOLD. II. Gammel–Brueckner Potential. Hennell, M. A.; Delves, L. M. (Univ. of Liverpool). Nucl. Phys.; A204: No. 3, 552-560(1973).

Results for the $J^\pi = \frac{1}{2}^+$ state of ^{3}H and ^{3}He obtained using the Gammel–Brueckner (GB) nucleon–nucleon potential are presented. Comparison is made with the predictions of the Hamada–Johnston (HJ) potential for bound-state properties and N–d scattering. While the GB potential gives ^{3}H binding energy at −7.75 MeV, which is close to experiment, the Coulomb energy still remains low. The minimum in the electron scattering charge form factor is in worse agreement with experiment than that of HJ while the secondary maximum shows insufficient enhancement over the HJ results. The N–d doublet scattering length is closer to experiment than the results for HJ, but there still appears to be a discrepancy with experiment. These results partially support the suggestion that a two-nucleon potential of HJ type with a larger hard-core radius than HJ, but fitted to a smaller deuteron D-state probability, may give a reasonable representation of the three-nucleon data apart from the Coulomb energy. Evidence now appears strong from this latter parameter for a small charge asymmetry in the two-nucleon potential. (6 figures, 3 tables). (auth)

4044 DISPERSION RELATIONS AND LOW-ENERGY ELASTIC SCATTERING OF CHARGED PARTICLES FROM NUCLEI. II. Application to N–^{4}He Scattering. Plattner, G. R.; Viollier, R. D.; Trautman, D.; Alder, K. (Univ., Basel). Nucl. Phys.; A206: No. 3, 513-530(1973).

A "Coulomb-modified" dispersion relation is applied to low-energy p–^{4}He forward elastic scattering. To check the validity of the modification, the results are compared with those deduced from n–^{4}He elastic scattering. Completely analogous information is obtained for the two processes. The exchange of three bound nucleons is found to contribute strongly to N–^{4}He forward scattering. The corresponding ^{4}He–^{3}H–p and ^{4}He–^{3}He–n coupling constants are evaluated as $R_p = 3.8 \pm 0.3$ and $R_n = 3.0 \pm 0.3$, respectively. These constants are related to the strength of the asymptotic wave function of nucleons in ^{4}He and thus to the tail of the nucleon distribution. A comparison of R_p with the empirical proton distribution in ^{4}He as deduced from e–^{4}He elastic scattering shows excellent agreement. From R_p and R_n the effective ranges of the singlet ^{3}H–p and ^{3}He–n interactions in the ground state of ^{4}He are determined to be equal, in accordance with charge symmetry, and to have a value of $r_{eff} = 1.072 \pm 0.006$ fm. (7 figures) (auth)

4045 ^{2}H(d,p)^{3}H AND ^{2}H(d,n)^{3}He REACTIONS AND THE EXCITED STATE OF ^{4}He AT 23.9 MeV. Ying, N.; Cox, B. B.; Barnes, B. K.; Barrows, A. W. Jr. (Army Ballistic Research Labs., Aberdeen Proving Ground, MD). Nucl. Phys.; A206: No. 3, 481-497(1973).

The relative differential cross sections were measured for the ^{2}H(d,p)^{3}H and the ^{2}H(d,n)^{3}He reactions from 300 keV to 700 keV in 50 keV steps. Angular distributions of all charged particles from the reactions were taken from 20° to 160° in the laboratory system. Energy-dependent asymmetry coefficients from the expansion of the center-of-mass angular distributions in terms of even powers of cos θ were obtained, as were the branching ratios between the two reaction modes. The different energy dependences of the moments of the two cross sections were used to test the need for the existence of a recently reported T = 0 state in ^{4}He. (auth)

4046 INVERSE PROBLEM IN COMPLEX λ-PLANE WITH COULOMB INTERACTION WITH ACCOUNT OF ABSORPTION. Malyarov, V. V.; Poplavskii, I. V. (Odessa Construction-Engineering Inst.). Yadern. Fiz.; 16: No. 4, 873-878(Oct 1972). (In Russian).

An inverse problem on reconstructing from the data on charged particle scattering of nuclear potential in complex λ-plane at fixed physical value of energy is being solved. In this an account is made for absorption. The obtained method is used for construction of potential of two α-particle interaction from the experimental data at the energy 63.91, 69.91 and 77.55 MeV in the lab-system. (auth)

4047 GILBERT–SCHMIDT EXPANSION FOR THREE-PARTICLE AMPLITUDE. Narodetskii, I. M.; Gal'pern, E. S.; Lyakhovitskii, V. N. (Inst. for Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 4, 707-716(Oct 1972). (In Russian).

A separable expansion of three-particle amplitudes, based on Gilbert–Schmidt method is considered. It is shown that in the problem of three identical particles in the energy region below two-particle threshold a separable potential of Yamaguchi type

leads to the positive, as well as negative eigenvalues. The latter ones more distinctly manifest themselves for the state $S = T = \frac{1}{2}$. The convergence of the Gilbert–Schmidt series for a doublet and quartet length of nd-scattering has been studied. An expansion of three-particle eigenfunctions into a series in hyperspherical functions in six-dimensional space is considered. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 3793, 4022, 4037, 4097, 4204, 4260, 4270, 4274, and 4287.

4048 (COO-3129-33) ELECTROEXCITATION FORM FACTORS AND FIXED-MULTIPOLARITY SUM RULES. Deal, T. J.; Fallieros, S. (Brown Univ., Providence, R. I. Dept. of Physics). 1973. Contract AT(11-1)-3129. 10p. Dep. NTIS $3.00.

Sum rules are derived for form factors describing the longitudinal isoscalar electroexcitation of nuclear levels with definite multipolarity. The sum-rule limits are not constant numbers but functions of the momentum transfer. Their behavior for small and large momentum transfers is discussed. An application is also presented for the excitation of the first-excited state of ^{6}Li by inelastically scattered electrons. (auth)

4049 (IEA-251) PHOTONEUTRON CROSS SECTION OF ^{2}D, Li, ^{6}Li, AND Bi NEAR THRESHOLD. Cesar, M. F.; Kuniyosi, S.; Mafra, O. Y.; Goldemberg, J. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Nov 1971. 13p. INIS.

The (γ,n) cross sections of natural lithium, ^{6}Li and Bi have been determined, in the 5 to 10 MeV energy interval, using gamma rays produced by thermal neutron capture. The obtained cross section varies from 0.04 mb at 6.05 MeV up to 0.73 mb at 9.72 MeV with a precision about 20%. (INIS)

4050 (RLO-1388-198) ACCELERATOR PRODUCTION OF ^{8}B NEUTRINOS. Marrs, R. E.; Bodansky, D.; Adelberger, E. G. (Washington Univ., Seattle. Dept. of Physics). 1973. 12p. Dep. NTIS $3.00.

The ^{8}B yield from the reaction ^{6}Li(^{3}He,n)^{8}B was measured from 8.9 to 26.5 MeV (lab) by counting the annihilation γ rays from the 0.762-s positron decay of ^{8}B. The measurement was motivated by the negative results of the Davis solar neutrino experiment, and the consequent possible usefulness of direct tests of neutrino detection systems with neutrinos from the decay of ^{8}B. The present upper limit on the capture of solar neutrinos in ^{37}Cl is 1 SNU, corresponding to a flux of 0.74×10^{6} ^{8}B neutrinos per cm^{2}-s. It was found that a ^{3}He^{+} current of 30 mA at 24 MeV is required to produce this ^{8}B neutrino flux at a distance of 8 m from the target, this result indicating that the contemplated test is not impossible. (3 figures) (auth)

4051 (RLO-1388-201) MEASUREMENT AND MICROSCOPIC ANALYSIS OF THE ^{6}Li(^{6}Li,^{6}Li*(3.56))^{6}Li*(3.56) AND THE ^{6}Li(^{6}Li, ^{6}He)^{6}Be REACTIONS. Wharton, W. R.; Cramer, J. G.; Wilkinson, D. H.; Calarco, J. R.; Nair, K. G. (Washington Univ., Seattle. Dept. of Physics). 1972. 11p. Dep. NTIS $3.00.

Angular distributions and an excitation function were measured for the ^{6}Li(^{6}Li,^{6}Li*(3.56))^{6}Li*(3.56) and the ^{6}Li(^{6}Li,^{6}He)^{6}Be reactions at laboratory bombarding energies between 28 and 36 MeV. A microscopic DWBA analysis which includes the tensor interaction and exchange gives good agreement with the data, except at forward angles, and predicts the correct magnitude of the cross sections. Estimates of the strengths of the effective Majorana and spin-tensor isospin interactions are given. (auth)

4052 (RLO-1388-203) EVIDENCE FOR TWO-NEUTRON EXCHANGE IN THE ELASTIC AND INELASTIC SCATTERING OF ^{18}O BY ^{16}O. Reisdorf, W. N.; Lau, P. H.; Vandenbosch, R. (Washington Univ., Seattle). 1972. 10p. Dep. NTIS $3.00.

Elastic and inelastic scattering cross sections for the ^{16}O(^{18}O, ^{18}O)^{16}O reaction were measured at more backward angles than previously. The anomalous back-angle peaking observed cannot be satisfactorily accounted for by an l-dependent optical potential but is shown to be consistent with two-neutron exchange. (auth)

4053 DIPOLE STATES OF MASS-11 NUCLEI. Spicer, B. M.; Fraser, R. F. (Univ. of Melbourne, Parkville, Australia). Aust. J. Phys.; 26: No. 1, 7-16(Feb 1973).

Calculations of the even-parity states of mass-11 nuclei in the 1p–2h basis are presented, and the results are compared with experimental data from inelastic electron scattering, the ^{11}B(γ,n) and ^{11}B(γ,p) cross sections, and the ^{10}B(p,γ_0) excitation function. (auth)

4054 α-PARTICLE MODEL OF THE ROTATION SPECTRUM OF ^{12}C. Fuller, R. C. (Inst. for Theoretical Physics, Heidelberg). Phys. Lett.; 43B: No. 6, 445-448(19 Mar 1973).

It is shown that the 0^{+}, 2^{+}, 4^{+} rotation spectrum and an oblate deformed ground state for ^{12}C are consistent with a simple α-particle model for its long range structure. (auth)

4055 T = 1 EXCITATION MECHANISM IN PION INDUCED REACTIONS ON ^{12}C. Cannata, F.; Ros, J. (Oxford Univ.). Phys. Lett.; 43B: No. 6, 467-469(19 Mar 1973).

The cross sections for the reactions $\pi^{\pm} \rightarrow \pi^{\pm}$, π^{0} on ^{12}C with excitation of the T = 1 states are calculated for the N^{*}_{33} energy region. The Chew–Low amplitude for pion–nucleon scattering is used in the framework of impulse approximation which has been supported by recent calculation of pion scattering with excitation of definite nuclear states. (auth)

4056 COULOMB EFFECTS IN π^{+}-C AND π^{-}-C TOTAL CROSS SECTIONS. Clough, A. S. (Univ. of Surrey, Guildford, Eng.); Turner, G. K.; Allardyce, B. W.; Batty, C. J.; Baugh, D. J.; McDonald, J. D.; Riddle, R. A. J.; Watson, L. H.; Cage, M. E.; Pyle, G. J.; Squier, G. T. A. Phys. Lett.; 43B: No. 6, 476-478 (19 Mar 1973).

Total cross sections for π^{+}-C and π^{-}-C were measured in the energy range 90 to 850 MeV. Significant differences are found between the total cross sections for the two charge states and these are compared with predictions of a number of models. (auth)

4057 DEPENDENCES OF THE YIELDS OF PIONS AND PROTONS, PRODUCED AT $\theta_{lab} = 90°$ AT $E_{\gamma}^{max} = 400$ MeV UPON NUCLEUS MASS NUMBER. Goncharov, N. V.; Derebchinskii, A. I.; Konovalov, O. G.; Tonapetyan, S. G.; Khvorostyan, V. M. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 17: No. 2, 242-249 (Feb 1973). (In Russian).

The yields of charged pions and protons, produced at $\theta_{lab} = 90°$ in interaction of photons with $E_{\gamma}^{max} = 400$ MeV with ^{12}C, ^{28}Si, ^{40}Ca, ^{93}Nb, ^{181}Ta nuclei were studied. A freon bubble chamber was used as a particle detector. This fact allowed one to detect simultaneously charged mesons within the kinetic energy interval (30 to 120) MeV and protons within the energy range (70 to 240) MeV. The dependences of pion and proton yields upon the nucleus mass number were obtained. A conclusion is made that pion photoproduction takes place within the whole nucleus space and the proton yield at $\theta_{lab} = 90°$ is mainly due to pion absorption in the nucleus. (auth)

4058 THREE-PARTICLE DECAYS OF ^{6}Li. Artemov, K. P.; Gol'berg, V. Z.; Petrov, I. P.; Rudakov, V. P.; Serikov, I. N.; Timofeev, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 2, 225-228(Feb 1973). (In Russian).

The modes of decay of 5.35 MeV ($J^{\pi} = 2^{+}$; T = 1) ^{6}Li state populated in ^{7}Li(^{3}He,α)^{6}Li and ^{9}Be(p,α)^{6}Li reactions were studied with the coincidence method. An estimation of the branching ratio for decays in several channels was obtained. The α-particle spectrum of the decay which leads in the final state to $\alpha + p + n$, reveals a characteristic peculiarity, which testifies to correlation between proton and neutron of the final state. Thus, investigation of α-particle spectrum of the decay of ^{6}He first excited state (analog of 5.35-MeV level in ^{6}Li) can provide new information on nn-interaction. (auth)

4059 BINDING ENERGIES IN (1d,2s) SHELL NUCLEI. Gross, R.; Talmi, I. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 44B: No. 2, 147-150(16 Apr 1973).

Binding energies of nuclei throughout the (1d,2s) shell were calculated with a modified surface delta interaction. The full energy matrices within the complete space of all configurations containing $1d_{\frac{5}{2}}$,$2s_{\frac{1}{2}}$ and $1d_{\frac{3}{2}}$ protons and neutrons were diagonalized. In spite of the crudeness of the interaction used, fair agreement is obtained between calculated and experimental energies. In particular, the calculated curve of α-particle separation energies shows kinks closely following the experimental ones. (auth)

4060 OCCUPATION PROBABILITIES AND SPIN CUT-OFF FACTORS. Chang, F. S. (Univ. of Pennsylvania, Philadelphia); French, J. B. Phys. Lett.; 44B: No. 2, 135-138(16 Apr 1973).

Examples are given, for both noninteracting and interacting particles, of the evaluation of orbit occupancies and spin cut-off factors by parametric differentiation on the state density. (auth)

4061 PHOTONUCLEAR PHYSICS, 1971. Fuller, E. G. (National Bureau of Standards, Washington, DC). pp 197–205 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The field of photonuclear physics with real photons is reviewed,

and the validity of existing models is discussed. Theoretical results for the cross section for photodisintegration of the deuteron are still incorrect by 10%. The ratio of (γ,p) to (γ,n) cross sections, which should be 1.0 if isospin is a good quantum number, varies with both incident energy and target. The importance of knowing the bremsstrahlung spectrum well is examined. Experiments done on transition nuclei indicate a marked change in the shape of the giant resonance when the number of neutrons is increased from N = 88 to N = 90, and this result is reproduced by Dynamic Collective Model calculations. Detailed microscopic calculations show that rather striking changes of shape occur in cross sections, depending on whether the nucleus is pictured as being made up of neutrons and protons or only one type of particle. In general, the effect of putting both neutrons and protons in the calculations is to decrease the magnitude of the structure in the cross section. In conclusion, a call for more precise, documented experiments is issued. (6 figures) (RWR)

4062 MEASUREMENT OF YIELD CURVES FOR (γ,Σn) REACTIONS USING BREMSSTRAHLUNG SPECTRUM. Baciu, G.; Catana, D. (Inst. for Atomic Physics, Bucharest). pp 207–212 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The need for high-resolution measurements of excitation functions for photonuclear reactions is pointed out, and the extraction of cross sections from experimental data is discussed. The setup for measuring yield curves using a bremsstrahlung spectrum at the Institute for Atomic Physics, Bucharest, is described; block diagrams for the electronics are included. The advantages of this system for measuring yield curves are the independence of the detection system drift, the improvement of dose monitoring, and the possibility of taking into account the parameters of the betatron target. (4 figures) (RWR)

4063 MEASUREMENT OF THE TOTAL PHOTONEUTRON CROSS SECTION OF ^{12}C FROM THRESHOLD TO 33 MeV. Van de Vijver, R.; Ferdinande, H.; Knuyt, G.; Carchon, R.; Devos, J. (State Univ., Ghent). pp 213–216 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The $^{12}C(\gamma,xn)$ reaction was produced in a natural carbon target by the bremsstrahlung beam from the linac. The photoneutrons were detected by a Halpern-type system. Penfold and Leiss' analysis method as well as Cook's method was applied. The shape of the giant resonance is in good agreement with that observed in previous experiments. (auth)

4064 STRUCTURE IN THE ^{19}F (γ,xn) REACTION CROSS SECTION. Catana, D.; Baciu, G.; Iliescu, C.; Obris, V.; Orbesteanu, M. (Inst. for Atomic Physics, Bucharest). pp 237–243 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

The ^{19}F (γ,xn) reaction cross section was measured in the energy interval 11 to 26 MeV with a bin of 100 keV in measuring the yield curve. The cross section was obtained by using the Penfold–Leiss method with two forms of bremsstrahlung spectrum. Both spectra gave about the same behavior of the cross section at low energies, except for the absolute values—the main disagreement occurred at high energies. The experimental results are compared with the photoabsorption cross section computed by using the single-particle wave functions of an anisotropic harmonic oscillator; the electric dipole photoabsorption cross section is shown. The integrated computed cross section from 9 to 30 MeV is 381 mb. MeV, while the dipole sum rule gives a value of 398 mb. MeV for an exchange parameter of 0.5. The use of the thick-target bremsstrahlung spectrum in the forward direction should be more realistic than the Schiff spectrum when the beam is very well collimated. On the other hand, these measurements show the ability to resolve resonances of the order of 0.5 to 1 MeV width in (γ,xn) cross sections in the high-energy region (and narrower in the low-energy region) when bremsstrahlung is used as a photon source. Computation of the E_1 photoabsorption cross section based on the single-particle and rotational excitations using Nilsson levels showed itself capable of explaining the kind of resonance structure observed in the experimental photonuclear cross sections of F. (4 figures) (RWR)

4065 KINEMATIC CHARACTERISTICS OF HYDROGEN AND HELIUM ISOTOPES IN REACTIONS $^{22}Ne + ^{12}C$ AND $^{22}Ne + ^{27}Al$. Avdeichikov, V. V.; Lozhkin, O. V.; Perfilov, N. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2614-2620(Dec 1972). (In Russian).

The mass spectra of light products in the reactions $^{22}Ne + ^{12}C$ and $^{22}Ne + ^{27}Al$ showed that the isotopes formed were predominantly ^1H and ^4He. Ratios of cross sections of formation for ^1H, ^2H, ^3H, ^3He, ^4He, and ^6He were measured at an angle of 53°. Differential energy spectra for ^1H, ^2H, ^3H and ^4He in the subject reactions were determined. Alpha angular distributions are also shown. (6 figures, 1 table). (KSW)

4066 MECHANISM OF THE $^{12}C(d,p_0)^{13}C$ REACTION. Mashkarov, Yu. G.; Slabospitskii, R. P.; Borovlev, V. I. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2623-2626(Dec 1972). (In Russian).

The asymmetry of protons in the interaction of polarized deuterons with carbon nuclei was measured with a view to establishing the mechanism of the $^{12}C(d,p_0)^{13}C$ reaction. The vector analyzing power, P_D, of the reaction was investigated in the deuteron energy interval 1.9 to 3.0 MeV and for proton emission angles of 30, 45, and 150° (lab). The angular dependence of P_D at E_d = 1.4, 1.6, and 1.8 MeV was determined. (4 figures). (tr-auth)

4067 SEARCH FOR SOLAR-NEUTRINO RELATED M1 TRANSITIONS IN ^8Li USING 180° ELECTRON SCATTERING. Fagg, L. W.; Bendel, W. L.; Ensslin, N.; Jones, E. C. Jr. (Naval Research Lab., Washington, DC). Phys. Lett.; 44B: No. 2, 163-164 (16 Apr 1973).

The ^8Li analog of the 11.5 MeV, 0^+ state in ^8Be proposed to explain the low flux of high-energy solar neutrinos was searched for and not observed. An upper limit of 3 eV is placed on the M1 ground-state width of any such narrow 0^+ state. (auth)

4068 EXCITATION FUNCTION FOR THE REACTION $^{12}C(n,p)^{12}B$ AT NEUTRON ENERGIES OF 16 TO 18 MeV. Bobyr, V. V.; Primenko, G. I.; Rev'yuk, K. K.; Strizhak, V. I.; Totskii, Yu. I.; Tustanovskii, V. T. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2621-2622(Dec 1972). (In Russian).

The excitation function for the reaction $^{12}C(n,p)^{12}B$ was measured in the neutron energy range 16 to 18 MeV. The measurements were conducted by recording the β particles of ^{12}B, for which $T_{\frac{1}{2}} \sim 20$ msec and E_β (max) = 13.37 MeV. The experimental results suggest the existence of two resonances at incident-neutron energies of 16.8 and 17.7 MeV. (1 figure) (tr-auth)

4069 ELASTIC SCATTERING OF ^{13}C FROM ^{13}C. Helb, H. D.; Dueck, P.; Hartmann, G.; Ischenko, G.; Siller, F.; Voit, H. (Univ., Erlangen, Ger.). Nucl. Phys.; A206: No. 2, 385-392(1973).

Angular distributions and excitation functions for $^{13}C + ^{13}C$ elastic scattering were measured in the energy range E(lab) = 14.0 to 27.5 MeV. The angular distributions at E(lab) = 15, 16, 18, and 20 MeV can be described fairly well with the method of molecular wave functions. (4 figures, 2 tables) (auth)

4070 POLARIZATION AND PHASE SHIFTS IN $^7Li(p,p)^7Li$ FROM 0.4 TO 2.5 MeV AND THE STRUCTURE OF ^8Be. Brown, L. (Carnegie Institution of Washington, DC); Steiner, E.; Arnold, L. G.; Seyler, R. G. Nucl. Phys.; A206: No. 2, 353-373(1973).

Polarization was measured for 141 points in $^7Li(p,p)^7Li$ at energies from 0.67 to 2.45 MeV with a target of 20 keV thickness at 1 MeV. These data and the cross section measurements of others are reproduced by a set of phase shifts, which vary reasonably with energy and which are complex because reaction channels are open. The $^3S_1$, $^5S_2$, and ^5P phases suffice for the analysis. Equal amounts of channel spin mixing are required to describe the 0.44- and 1.03-MeV resonances, the analysis of the former resting on cross section data alone. The sign of the mixing for the 1.03-MeV resonance is determined from the polarization data. The nature of the 2^- state at the neutron threshold is clarified. The resonance at 2.05 MeV is identified as 3^+. The behavior of the $^5P_3$ phase in the region between this 3^+ state and the known 3^+ state at 2.25 MeV indicates that these states are coupled. (7 figures, 1 table) (auth)

4071 NUCLEAR MATTER DISTRIBUTIONS FOR $^{16,17,18}O$ FROM A MICROSCOPIC ANALYSIS OF ELASTIC PROTON SCATTERING. Lerner, G. M. (Texas A and M Univ., College Station). Nucl. Phys.; A205: No. 2, 385-397(1973).

An analysis of 65-MeV elastic proton scattering by $^{16,17,18}O$ was made in terms of a reformulated optical model. Matter distributions for ^{17}O and ^{18}O were obtained relative to ^{16}O. The results for the rms matter radii are $R_{17} - R_{16} = 0.04 \pm 0.03$ fm and $R_{18} - R_{16} = 0.35 \pm 0.07$ fm. (auth)

4072 NEUTRON–CARBON INTERACTION: TOTAL AND ELASTIC SCATTERING DIFFERENTIAL CROSS SECTIONS AND PHASE SHIFT ANALYSIS, 2.1 TO 4.7 MeV. Fasoli, U.; Metellini, A.; Toniolo, D.; Zago, G. (Univ., Padua). Nucl. Phys.; A205: No. 2, 305-320(1973).

A measurement of the neutron total and differential elastic scattering cross sections is described, performed by means of

the time-of-flight technique in the neutron energy interval 2.1 to 4.7 MeV. The experimental data were analyzed by the phase shift formalism, and the ^{12}C neutron analyzing power was calculated and compared with the results obtained by various authors. More precise values of some level parameters of ^{13}C were obtained in the excitation energy interval from 7 to 9 MeV. The calculated map of the polarization induced in neutron-^{12}C scattering indicates the energy and angle regions where carbon may be usefully employed as a polarization analyzer. (auth)

4073 ANALYSIS OF ANGULAR DISTRIBUTIONS IN THREE-PARTICLE REACTIONS. Eichner, H.; Stehle, H.; Heiss, P. (Univ., Cologne). Nucl. Phys.; A205: No. 2, 249-256(1973).

A model-independent description for angular distributions of sequential decay processes is given. The method and the notation are in close analogy to the treatment for two-particle processes given by Welton. In particular arbitrary ranks of tensor polarization of the final particles can be described. It is shown that from the angular distribution information about the quantum numbers J, π and the polarization of the unstable recoil nucleus can be gained. A simple application of the formalism to the $^{10}B(\alpha,2\alpha)^6Li$ reaction is given. (auth)

4074 EFFECT OF SHORT-RANGE CORRELATIONS IN THE REACTION $^{16}O(p,d)^{15}O$. Blum, B. (Univ., Erlangen, Ger.); Duennweber, W.; Hering, W. R. Nucl. Phys.; A206: No. 2, 321-331(1973).

Short-range correlations due to the repulsive core in the nucleon–nucleon interaction are incorporated into the nuclear wave function by using a Jastrow factor. The dependence of the transfer cross section on this effect and on different optical potentials is studied in the case of $^{16}O(p,d)^{15}O$. When these results are compared with the assumptions commonly used, an improvement is noted. (5 figures, 2 tables) (auth)

4075 HIGH-ENERGY PROTON SCATTERING ON NUCLEI. Klovning, A.; Kofoed-Hansen, O.; Schluepmann, K. (CERN, Geneva). Nucl. Phys.; B54: No. 1, 29-41(1973).

The high-energy proton scattering on Be, C, Cu and Pb targets was studied using a single-arm spectrometer. The projectile momenta were 19 and 24 GeV/c, the square of the four-momentum transfer varied from t = 0.1 to t = 4.4 GeV^2. Momentum distributions of scattered protons in the high-momentum range were recorded. An application of multiple-scattering theory yielded agreement of calculation and experimental results to within a ±30% uncertainty of the former. (auth)

4076 $(\pi^+,\pi N)$ REACTIONS ON CARBON AT 130 MeV: A BUBBLE CHAMBER EXPERIMENT. Bellotti, E.; Bonetti, S.; Cavalli, D.; Matteuzzi, C. (Univ., Milan). Nuovo Cim., 14A: No. 3, 567-590(1 Apr 1973).

The $(\pi^+,\pi N)$ reactions at ~130 MeV (kinetic energy) were investigated by means of a propane bubble chamber. About 250 events of quasi-elastic scattering on bound protons of the p and s shells have been analyzed and the results compared with the predictions of the impulse approximation model (IAM): the agreement is generally good. The following results were obtained: the best values for the parameter A appearing in the harmonic-oscillator form factors are A_p = (160 ± 10) MeV/c and A_s = (300 ± 30) MeV/c for p- and s-shell protons respectively; the total cross section for the (π^+,π^+p) reaction is (66 ± 10) mb and the ratio between the cross sections for the separation of a p- or a s-proton is 1.5 ± 0.2. About 100 charge exchange events were collected; the corresponding cross section is (36 ± 5) mb, while the estimated σ for (π^+,π^0p) is (18 ± 3) mb. In the limit of the statistics it seems that also this reaction can be explained on the basis of the IAM. Data concerning the reactions (π^+,π^+n) based on ~100 events show some discrepancies with the IAM predictions which cannot be easily explained by the poor statistics and by the difficulties of the experimental analysis. The ratio between the cross sections for separation of a p and of a n is 1.7 ± 0.2. (auth)

4077 QUASI-ELASTIC ELECTRON SCATTERING BY ^{12}C NUCLEI IN THE SHELL MODEL. Fursa, A. D.; Tartakovskii, V. K.; Kozlovskii, I. V. (Inst. of Theoretical Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 372-377(Mar 1973). (In Russian).

The energy spectra of electrons scattered inelastically by ^{12}C nuclei are calculated. The cross section of the process summarized from all final states of the system was expressed in terms of spectral distributions for two-particle correlation functions which were calculated for ^{12}C, using the oscillator shell model without spin-orbit interaction. The calculations performed with different structure parameters are compared with experimental data. (auth)

4078 GENERALIZED METHOD OF HARMONIC POLYNOMIALS. Gorbatov, A. M. (Kalinin State Univ., USSR). Yadern. Fiz.; 16: No. 4, 699-706(Oct 1972). (In Russian).

A method of hyperspherical functions is being generalized by introducing a collective variable of a wider form, that equals a sum of squares of some curvilinear coordinates of particles. The calculated scheme of the method worked out is demonstrated by the example of ^{16}O nucleus. The quantitative estimations lead to large values of nucleus binding energy as compared with those in K-harmonics method. (auth)

4079 FORM FACTORS AND TRANSITION DENSITIES OF QUADRUPOLE AND OCTUPOLE ^{12}C NUCLEUS OSCILLATIONS. Gul'karov, I. S. (Tashkent Polytechnical Inst.). Yadern. Fiz.; 16: No. 4, 689-698(Oct 1972). (In Russian).

Form-factors of the levels 4.43 MeV (2^+) and 9.64 MeV (3^-) of ^{12}C nucleus are compared with those calculated in the framework of the Helm phenomenological model and modified Tassi model. The best agreement between theory and experiment appears to be possible, if the parameters of charge density distributions are changed by 5–10%. The transition radii, obtained in the framework of modified Tassi model, agree well with those obtained by a model independent method. (auth)

4080 PARTIAL TRANSITIONS DURING μ-MESON CAPTURE BY THE ^{19}F NUCLEUS. Khok, G. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 786-788(Apr 1972). (In Russian).

Partial transitions in the ^{19}F nucleus are of interest because both the absolute values and the ratio of the partial transition probabilities are known; therefore, these transitions and their dependence on the nuclear matrix elements were investigated. The work involved calculation of the velocity of permitted partial transitions $\mu^- + {}^{19}F \rightarrow {}^{19}O + \nu$ to the $3/2^+$ level, with E^* = 0.097 MeV; $1/2^+$, E^* = 1.47 MeV. The ^{19}O nucleus also contains 3 related states with the characteristics of $3/2^+$, 2.37 MeV; $1/2^+$, 3.24 MeV; and $(3/2^+, 5/2)$, 4.12 MeV. The experimental data concerning this excitation level are incomplete; therefore, a theoretical scheme was used for the study. The results indicated that the characteristics of the transitions are strongly dependent on the parameters of the V_0 model and are much less sensitive with respect to the muon–nucleon interaction constants. At present the V_0 parameter is only insufficiently known. It was concluded that study of partial transitions in ^{17}F is not suited to obtain information about the muon–nucleon interaction constants. (TTT)

4081 INVESTIGATION OF MIRROR REACTIONS $(^3He,n)$ AND $(^3He,p)$ ON ^{12}C NUCLEUS. Brill, O. D.; Vongai, A. D.; Gridnev, K. A.; Faiziev, A. R. Yadern. Fiz.; 16: No. 4, 640-648(Oct 1972). (In Russian).

The differential cross sections for $^{12}C(^3He,n)^{14}O$ reaction at the energy 13.3 and 18.2 MeV and $^{12}C(^3He,p)^{14}N$ at 13.3 MeV were measured. The experimental results are compared with calculations of a two-nucleon transfer reaction with the distorted wave method. Relative spectroscopic factors for four lower bound states of ^{14}O and ^{14}N nuclei were obtained for ^3He ion energy interval 13 to 20 MeV. A new state of ^{14}O nucleus with the energy 9.95 ± 0.043 MeV and the width $\Gamma_{c.m.s.}$ = (100 ± 50) keV and the characteristics $J^\pi = 3^-$ is found. The most probable candidate for the analog of this state is 3^-; 12.69 MeV level of ^{14}N nucleus. (auth)

4082 $^{14}C(p,\gamma_0)^{15}N$ CROSS SECTION BELOW E_p = 12 MeV. Weller, H. R. (Univ. of Florida, Gainesville); Blue, R. A.; Ramirez, J. J.; Bernstein, E. M. Nucl. Phys.; A207: No. 1, 177-181(1973).

The cross section for the $^{14}C(p,\gamma_0)^{15}N$ reaction was measured up to E_p = 12 MeV. These measurements cover the region of the main component of the giant dipole resonance in ^{15}N previously observed in the inverse $^{15}N(\gamma,p_0)^{14}C$ reaction. The structures seen are compared with recent measurements of the $^{14}N(p,\gamma_0)^{15}O$ cross section at corresponding energies in ^{15}O, this procedure allowing clear identification of T = 1/2 and 3/2 states. A comparison of the present experimental results is also made with recent bound and continuum shell-model calculations for this region of ^{15}N. (auth)

4083 DECAY OF THE PHOTORESONANCE IN ^{14}N AND ^{14}C NUCLEI. Kissener, H. R. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.); Eramzhyan, R. A.; Jaeger, H. U. Nucl. Phys.; A207: No. 1, 78-90(1973).

The decay of the photoresonances in ^{14}N and ^{14}C nuclei is analyzed in terms of the shell model with intermediate coupling. Cross sections and branching ratios of nucleon channels are compared with experimental data. Successive decay branches are estimated. (9 figures, 4 tables) (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 2776, 3793, 4057, 4059, 4065, 4097, 4160, 4204, 4240, and 4285.

4084 REACTION $^{26}Mg(d,\tau)^{25}Na$ AND THE STRUCTURE OF ^{25}Na. Jaenecke, J. (Univ. of Michigan, Ann Arbor). Nucl. Phys.; A204: No. 3, 497-515(1973).

The nuclear structure of the nucleus ^{25}Na was studied with the $(d,^3He)$ proton pickup reaction on ^{26}Mg at a bombarding energy of 29 MeV with an energy resolution of 25 to 30 keV FWHM. Excited states in ^{25}Na were measured up to excitation energies of 8 MeV. The experimental angular distributions show good agreement with the predictions from the standard distorted-wave Born-approximation theory (code DWUCK; nonlocal and finite range). However, the agreement is improved considerably if the procedure of Kunz, Rost, and Johnson is applied which accounts approximately for strong couplings to inelastic channels in the initial and final (strongly deformed) nuclei. The influence of this treatment on the evaluation of spectroscopic factors was investigated and found to be particularly pronounced for $l = 0$ transitions. The measured spectroscopic factors are compared to those from other experimental work and from shell-model and Nilsson-model calculations. (auth)

4085 ANALYSIS OF (d,pγ) REACTIONS. Steketee, C. F.; McKellar, B. H. J. (Univ. of Sydney). Aust. J. Phys.; 26: No. 1, 25-41(Feb 1973).

The reactions $^{24}Mg(d,p\gamma)^{25}Mg$ via the 3.40-MeV state, $^{40}Ca(d,p\gamma)^{41}Ca$ via the 1.95-MeV state, and $^{28}Si(d,p\gamma)^{29}Si$ via the 2.03-MeV state are analyzed using the stripping theory developed by Butler, Hewitt, McKellar, and May. The theory is in reasonable agreement with the experimental data. It is pointed out that a study of the correlation as a function of the proton scattering angle is necessary to obtain a test of this theory vis-a-vis the standard DWBA theory of stripping reactions. (auth)

4086 ELASTIC SCATTERING OF POLARIZED PROTONS BY ^{26}Mg NUCLEI. Lopatko, I. D.; Andreev, G. B.; Borovlev, V. I.; Slabospitskii, R. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2627-2633(Dec 1972). (In Russian).

The excited states of the nucleus ^{27}Al were investigated by means of the elastic scattering of polarized protons by ^{26}Mg nuclei. Measurements were conducted at scattering angles of 95, 120, and 150° in the incident-proton energy range $E_p = 1.850$ to 2.200 MeV. The dependence of polarization on the energy of the incident protons was ascertained which facilitated the determination of the resonance energies of the six excited states of ^{27}Al. (3 figures, 1 table) (tr-auth)

4087 GAMMA-RAY TRANSITIONS FROM THE LOWEST T = 2 STATES OF ^{24}Na AND ^{28}Al. Start, D. F. H.; Jelley, N. A.; Burde, J.; Hutcheon, D. A.; Randolph, W. L.; Underwood, B. Y.; Warner, R. E. (Nuclear Physics Lab., Oxford). Nucl. Phys.; A206: No. 1, 207-216(1973).

The γ-ray decay modes of the lowest 0^+, T = 2 states of ^{24}Na and ^{28}Al were investigated with a Ge(Li) detector in the $^{22}Ne(^3He,p)^{24}Na$ and $^{26}Mg(^3He,p)^{28}Al$ reactions. Precise excitation energies of 5970.2 ± 0.9 keV and 5992.4 ± 0.4 keV were obtained for the ^{24}Na and ^{28}Al T = 2 states, respectively. These energies were used to calculate the masses of the $T_z = -1$ and -2 members of each isobaric quintet; the branching ratios are compared with those of the analogous isovector M1 transitions in ^{24}Mg and ^{28}Si and also with shell-model calculations. (3 figures, 2 tables) (auth)

4088 INVESTIGATION OF THE (d,α) REACTION ON THE ^{31}P NUCLEUS OVER THE DEUTERON ENERGY INTERVAL 2.8 TO 4.0 MeV. Vysotskii, G. L.; Zalyubovskii, I. I.; Kuznichenko, A. V.; Lobkovskii, A. P.; Ustimenkov, K. F.; Zabegai, V. M.; Melenevskii, A. E.; Nemets, O. F.; Nemykin, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2641-2645(Dec 1972). (In Russian).

The (d,α) reaction on the ^{31}P nucleus leading to the compound nucleus, ^{33}S, had previously been investigated by these authors in the excitation energy range of 17.9 to 19.0 MeV. This paper concerns the measurement of the angular distribution of α particles corresponding to the ground and the first six excited states of the final nucleus, ^{29}Si, at deuteron energies of 2.8 to 4.0 MeV. The differential cross sections obtained were compared with the theoretical, which were computed by means of statistical theory. (3 figures, 1 table) (KSW)

4089 POLARIZATION OF PROTONS WITH ENERGIES OF 5.75 TO 6.0 MeV DURING SCATTERING BY THE ^{28}Si NUCLEUS. Gustova, L. V.; Chubinskii, O. V.; Kuz'mitskii, I. V.; Andronov, Yu. F.; Vinogradov, L. I.; Kangropol, Yu. V. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2634-2640 (Dec 1972). (In Russian).

The angular dependence of proton polarization during elastic and inelastic (with excitation of the first 2^+ level) scattering by ^{28}Si nuclei was measured by the method of double scattering using a carbon polarimeter. The measurements were conducted at several proton energies in the interval 5.75 to 6.0 MeV. (5 figures, 2 tables) (tr-auth)

4090 MEASUREMENT OF THE VECTOR ANALYZING POWER OF THE STRIPPING REACTION $^{32}S(d,p)^{33}S$. Egoshin, V. G.; Ostapenko, A. A.; Saltykov, L. S.; Senyushko, V. A.; Chirko, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2646-2647 (Dec 1972). (In Russian).

A study of the stripping reaction $^{32}S(d,p)^{33}S$ was conducted for ground and excited states by using a polarized deuteron beam. Asymmetry was measured in the proton angular distribution over the angular interval 18 to 42°. The vector analyzing power of the reaction was studied as a function of the angle of the emitted protons. (1 table). (tr-auth)

4091 LIFETIMES OF ^{34}Cl LEVELS. Carola, T. P. G.; Sikora, B. (Rijksuniversiteit, Utrecht). Nucl. Phys.; A206: No. 2, 427-432(1973).

Levels of ^{34}Cl were populated with the $^{32}S(^3He,p)^{34}Cl$ reaction at $E_{^3He} = 9$ MeV. Gamma rays were detected in coincidence with protons. From Doppler-shift-attenuation measurements, mean lifetimes (or limits) were obtained for 18 levels below $E_x = 4.5$ MeV. Multipole strengths were calculated for a number of transitions and compared, where possible, with many-particle shell-model calculations. The present work determines $J_\pi = 1^-$ and $(2,3)^-$ for the 4.35- and 4.46-MeV levels, respectively. (auth)

4092 SHELL MODEL CALCULATIONS FOR MASSES 27, 28, AND 29: SPECIFIC APPLICATION TO $^{27,28}Mg$ AND $^{28,29}Al$. De Voigt, M. J. A. (Univ. of Rochester, NY); Wildenthal, B. H. Nucl. Phys.; A206: No. 2, 305-320(1973).

A shell-model calculation was performed in a truncated $1d_{\frac{5}{2}}$, $2s_{\frac{1}{2}}$, $1d_{\frac{3}{2}}$ configuration space with a modified surface-delta-interaction Hamiltonian for the T = 1, $\frac{3}{2}$, and 2 nuclei of A = 27 to 29. The parameters of the model Hamiltonian were obtained from a fit to experimental data from T = 0 and T = $\frac{1}{2}$ nuclei of the same region. Excitation energies, single-nucleon spectroscopic factors, electric quadrupole moments and transition strengths, and magnetic dipole moments and transition strengths were calculated. Decay properties of the T = 2 and T = 1 multiplets in A = 28 and the $\Delta T = 1$, M1 transitions from T = $\frac{3}{2}$ levels in A = 27 and 29 nuclei were studied in particular. The results indicate that the present shell model is able to describe quantitatively the nuclear structure around mass 28 in a unified approach in a fashion similar to the excellent descriptions available in this same theoretical framework for lighter and heavier mass regions of the sd shell. (3 figures, 6 tables) (auth)

4093 INELASTIC EFFECTS IN NUCLEON PICKUP REACTIONS ON ^{24}Mg AND THE STRUCTURE OF ^{23}Na AND ^{23}Mg. Nelson, R. O. Durham, NC; Duke Univ. (1972). 133p. University Microfilms Order No. 73-8092.

Thesis (Ph. D.).

Thirteen states of ^{23}Na with excitation energies <5.5 MeV and their analog states in ^{23}Mg were studied with the $^{24}Mg(d,^3He)^{23}Na$ and $^{24}Mg(d,t)^{23}Mg$ reactions at the deuteron bombarding energy of 21.1 MeV. From a coupled-channels Born-approximation (CCBA) analysis of the angular distributions, it was possible to identify mirror states of the nuclei and to establish for ^{23}Mg spin and parity assignments of $\frac{9}{2}^+$, $\frac{3}{2}^+$, $(\frac{5}{2}^+)$, $(\frac{5}{2}^-)$, $(\frac{7}{2}^+)$, and $(\frac{5}{2}^+)$ for the levels at 2.71, 2.90, 3.86, 3.97, 4.68, and 5.29 MeV, respectively. Initial attempts to fit the distributions with the distorted-wave Born approximation (DWBA) could not reproduce the pronounced differences observed between known $l = 2$ angular distributions. A subsequent measurement of the differential cross section for inelastic scattering for 21.1-MeV deuterons by ^{24}Mg revealed that at back angles the inelastic cross sections were frequently greater than the cross section for elastic scattering. Since this fact violates the assumption of DWBA theory that elastic scattering is the predominant interaction process, a CCBA analysis explicitly including effects from inelastic scattering was performed. The calculations of the present study imply that the experimental angular distributions for the $^{24}Mg(d,^3He)$ and $^{24}Mg(d,t)$ reactions are generally consistent with a Nilsson strong-coupling model of ^{23}Na and ^{23}Mg if band-mixing is included. This conclusion is critically dependent on the inclusion of inelastic effects, without which agreement with the data is not possible. (Diss. Abstr. Int., B)

4094 LIFETIME MEASUREMENTS IN ^{36}Ar AND ^{36}Cl USING THE RECOIL DISTANCE METHOD. Nolan, P. J.; Butler, P. A.;

Carr, P. E.; Gadeken, L. L.; James, A. N.; Sharpey-Schafer, J. F.; Viggars, D. A. (Univ. of Liverpool). J. Phys., A (London); 6: No. 4, L37-L40(Apr 1973).

The recoil distance method has been used to measure the mean lifetimes of the 788 keV, 1164 keV, 2519 keV and 2810 keV levels in ^{36}Cl and of the 4178 keV and 5171 keV levels in ^{36}Ar. The measured lifetimes are 30 ± 1 ps, 7.1 ± 0.5 ps, 2.36 ± 0.16 ps, 9.0 ± 0.6 ps, less than 8 ps and 127 ± 5 ps, respectively. The data support a correspondence between the 2519 keV and 2810 keV levels of ^{36}Cl with 5^- and 4^- states given by the shell model calculations of Erne (Nucl. Phys. A.; 84: 91-105(1966)). (auth)

4095 CONTRIBUTION OF DIRECT INTERACTIONS IN CROSS SECTIONS OF NEUTRON SCATTERING BY Mg, Ti, Cr, ^{58}Ni, ^{60}Ni, ^{62}Ni. Sokolov, L. S.; Fedorov, M. B.; Korbetskii, E. V.; Surovitskaya, N. T.; Yakovenko, T. I. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 2, 263-266(Feb 1973). (In Russian).

The differential cross sections of potential scattering are calculated by means of a generalized optical model of a nucleus in assumption of vibrational nature of excited states. The angular distributions of the compound scattered neutrons are calculated by the Hauser–Feshbach statistical theory. The sum of potential and compound scattering is compared with the experimental data. The relation of the potential scattering and compound scattering cross sections are within the limits of 1 : 2 to 1 : 9 in case of inelastic scattering with excitement of states 2^+ and within the limits of 1 : 0.05 to 1 : 0.67 in case of elastic scattering. (auth)

4096 GAMMA RAYS RESULTING FROM NONELASTIC PROCESSES OF 14.2 MeV NEUTRONS WITH SODIUM, MAGNESIUM, SILICON, SULPHUR, TITANIUM, CHROMIUM, AND IRON. Abbondanno, U.; Giacomich, R.; Lagonegro, M.; Pauli, G. (Univ., Trieste, Italy). J. Nucl. Energy; 27: No. 4, 227-239(Apr 1973).

Gamma rays resulting from the interaction of 14.2 MeV neutrons with ^{23}Na, ^{24}Mg, ^{28}Si, ^{32}S, ^{48}Ti, ^{52}Cr and ^{56}Fe were investigated. The incident neutrons were produced by means of the T(d,n)^{4}He reaction. The associated-particle time-of-flight technique was used to discriminate between the neutrons and the gamma rays resulting from the nonelastic scattering processes. The differential gamma-ray production cross-sections were measured for gamma rays with energies of 0.44, 0.64, 1.27, 1.63 MeV for ^{23}Na; for a gamma ray with energy of 1.37 MeV for ^{24}Mg; for a gamma ray with energy of 1.78 MeV for ^{28}Si; for gamma rays with energies of 1.27, 2.06, 2.24 MeV for ^{32}S; for gamma rays with energies of 0.99 and 1.31 MeV for ^{48}Ti; for gamma rays with energies of 0.93, 1.33, 1.43 MeV for ^{52}Cr; for gamma rays with energies of 0.85 and 1.24 MeV for ^{56}Fe. The integrated gamma-ray production cross-sections were also deduced. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 4037, 4057, 4059, 4060, 4085, 4095, 4096, 4134, 4138, 4160, 4204, and 4288.

4097 (FRNC-TH-340) DISTORTED WAVE ANALYSIS OF (p,2p) REACTIONS AT 600 MeV. Lemeilleur, F. (CAEN Univ. (France)). 1971. 82p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis.

The results of measurements on the separation energies of protons from the 1s and 1p shells of ^{12}C and deeper-lying shells of ^{28}Si, ^{40}Ca, ^{51}V, and ^{90}Zr made by analyzing (p,2p) reactions on nuclei are presented. The separation energy spectra exhibit partially resolved peaks; a method was developed for isolating the 1s peak from other peaks in each of the spectra. Comparisons between the different absorptions measured for the various shells and between the occupation numbers given by the shell model and those obtained using the DWIA demonstrate that the (p,2p) cross sections are strongly enhanced by the contribution of inelastic reactions when the interactions take place in the central region of the nucleus. Fits made between the theoretical and experimental distributions for the recoil momentum enabled the parameters of the harmonic oscillator wave functions to be determined and the subsequent deduction of the mean radii of the different nuclear shells. The recoil momentum direction parameter was introduced in the cross sections. It is shown that this parameter is fundamental for studies of the reaction mechanism. (FR)

4098 ANGULAR AND ENERGY DISTRIBUTIONS OF NEUTRON SCATTERING ON Fe AND Ni NUCLEI. Tertychnyi, G. Ya.; Shubin, Yu. N. Yadern. Fiz.; 17: No. 2, 287-292(Feb 1973). (In Russian).

Inelastic scattering of neutrons with energy 14 MeV on Fe and Ni nuclei is analyzed. To determine the mechanisms through which inelastic scattering goes and to detect the contribution of the process, which goes through a compound nucleus, calculations of angular and energy distributions of inelastically scattered neutrons were carried out on the basis of the Hauser–Feshbach statistical approach with a precise account of the contribution of each angular momentum. The calculation results point to the presence of weak anisotropy with respect to 90° angle. Unequilibrium process contribution, estimated in the Griffin model, at 90° is 25% for Fe and 20% for Ni. From comparison with the experiment, neutron energy distribution from (n,2n) and (n,pn) reaction, which gives the total cross section, coinciding with experiment was obtained. (auth)

4099 CONFIGURATIONAL MIXING AND THE MAGNETIC MOMENT OF $f_{\frac{1}{2}}$-NUCLEONS. Erikson, T. (Nordita, Copenhagen). Phys. Lett.; 43B: No. 6, 453-454(19 Mar 1973).

It is shown that, after the corrections due to deformed components in the wave functions have been removed, the new measurement of the magnetic moment of the 6^+ state in ^{42}Ca together with the corresponding results from ^{41}Ca, ^{41}Sc as well as the β-decay results ^{41}Sc → ^{41}Ca, fit a picture in which the correction to the Schmidt magnetic moment of the $f_{\frac{1}{2}}$ nucleons is pure isovector and consists of a 10 percent reduction of the $(\Sigma\sigma_2\tau_3)$ and $\delta g_1 = 0.15\ \tau$. (auth)

4100 0^+ STATES NEAR THE N = 20 NEUTRON SHELL FROM Ar(t,p) REACTIONS. Phys. Lett.; 43B: No. 6, 473-475(19 Mar 1973).

The (t,p) reactions leading to ^{38,40,42}Ar and ^{42}Ca were used to study the 0^+ level spectrum near the N = 20 neutron closed shell. The Ar isotopes show a significant reduction and fragmentation of the L = 0(t,p) strength relative to Ca. A major change in the structure of the 0^+ levels thus takes place between Ca and Ar. (auth)

4101 LIFETIMES OF EXCITED STATES OF ^{38}Ca AND ^{39}K. Kessel, W.; Bass, R.; Wechsung, R. (Univ., Frankfurt am Main). Nucl. Phys.; A206: No. 1, 193-206(1973).

The mean lifetimes of levels in ^{39}Ca and ^{39}K were measured with the Doppler-shift attenuation method. With the ^{40}Ca(^{3}He,$\alpha\gamma$)^{39}Ca reaction and $\alpha-\gamma$ coincidence measurements the mean lifetimes, τ_m, of the 2.47- and 2.80-MeV states were found to be 260 ± 80 fs and >16 ps, respectively. The lifetimes of the 2.81- and 3.60-MeV states of ^{39}K were measured using the reaction ^{36}Ar(α,pγ)^{39}K and stopping the recoils in the target gas. The mean lives for these two levels are 63 ± 10 ps and 60 ± 9 ps, respectively. (auth)

4102 GAMMA DECAY OF EXCITED LEVELS OF ^{51}Ti. Lamaze, G. P. Durham, NC; Duke Univ. (1972). 138p. University Microfilms Order No. 73-8086.

Thesis (Ph. D.).

The excited states of ^{51}Ti populated with the reaction ^{50}Ti(d,pγ)-^{51}Ti were studied with the angular-correlation method. The observed protons were detected in an annular semiconductor counter positioned at 180° relative to the beam direction. A spin and parity assignment of $9/2^+$ was established for the level at 3774 keV. Correlations for other levels did not yield unique spin assignments. Branching ratios were measured for the levels at 1167, 2144, 2198, 2907, 3174, 4162, 4592, 4747, 4810, 4882, 5139, 5214, and 5440 keV. New levels were observed at 2346 keV and 5440 keV. The reaction ^{48}Ca(α,nγ)^{51}Ti was also used to populate many levels of ^{51}Ti. The resultant decays were studied with n–γ and $\gamma-\gamma$ coincidence techniques using 30-cm^3 and 80-cm^3 Ge(Li) detectors. Five previously unreported levels were observed at 2733, 2755, 2922, 3235, and 3636 keV. Additionally, tentative assignment of three previously unreported levels was made. These levels are at 3473, 3619, and 5785 keV excitation. The decay scheme of ^{51}Ti is compared with the other N = 29 nuclei (^{49}Ca, ^{53}Cr, ^{55}Fe, and ^{57}Ni). Comparisons are also made with model predictions. These calculations succeed in accounting for the number of new levels seen. (Diss. Abstr. Int., B)

4103 MEASUREMENT OF PHOTONUCLEAR CROSS SECTIONS FOR DIFFERENT REACTION CHANNELS USING BREMSSTRAHLUNG GAMMA RAYS FROM A BETATRON. Brajnik, D.; Jamnik, D.; Kernel, G.; Miklavzic, U.; Stanovnik, A.; Tiringer, M. (Institut Jozef Stefan, Ljubljana, Yugoslavia). pp 217–236 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068–.

After a brief introduction concerning the measurement of cross sections by using monochromatic gamma radiation and bremsstrahlung sources, a method for measuring photoproton cross sections is described in which the location and the extent of popu-

lation of the residual excited states are independently determined in a separate experiment by detecting gamma rays resulting from the decay of residual states involved in the reaction. Once the states of the residual nucleus involved in the photonuclear process have been established, they can be used as known quantities in the analysis. The partial cross sections are then obtained numerically by means of a least-squares procedure. Gamma spectra and cross sections are presented for photoproduction of neutrons and protons from ^{40}Ca from threshold to 30 MeV. Excitation functions for the ^{40}Ca(γ,p) reaction were determined by a least-squares analysis of photoproton spectra. The following conclusions were drawn: the reactions cannot be quantitatively described in terms of 1p-1h shell-model coupled-channels calculation; the presence of an appreciable radiation width for the negative-parity hole channels could be explained by the impurities in the ground state of ^{40}Ca; the wave functions of the ^{40}Ca giant resonance state apparently contain more $1d_{\frac{3}{2}}$ hole configuration relative to the $1d_{\frac{5}{2}}$ configuration than predicted by a simple 1p−1h shell-model calculation; measured photoproton cross sections have similar gross structure for all channels. Preliminary spectra of photoprotons from ^{90}Zr are presented for endpoint energies from 14.7 to 23.8 MeV. (8 figures). (RWR)

4104 DETERMINATION OF THE FAST-NEUTRON CAPTURE CROSS SECTION FOR ^{75}As FROM PHOTONUCLEAR DATA. Deberth, C. (Inst. for Atomic Physics, Bucharest). pp 287−289 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068−.

The methods for the evaluation of cross sections for (n,γ) reactions are based on the compound-nucleus statistical model. In this paper the fast-neutron cross section evaluation for the ^{75}As(n,γ) ^{76}As reaction is given. The basic formula adopted for the theoretical calculations was the Hauser−Feshbach formula. The calculated excitation function from 0.001 to 10 MeV is compared with experimental data. (1 figure). (RWR)

4105 NEUTRON EMISSION IN MUON CAPTURE BY ^{40}Ca. Boussy, A.; Ngo, H.; Vinh Mau, N. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 44B: No. 2, 139-142(16 Apr 1973).

The neutron spectrum and asymmetry were calculated for ^{40}Ca with different wave functions for the bound proton and the emitted neutron. The asymmetry is shown to be very sensitive to the behavior of the wave functions near the nuclear surface while the spectrum is mostly sensitive to the strength of the real part of the neutron optical potential. (auth)

4106 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY ^{53}Cr. Aleksandrov, Yu. A.; Antropov, A. E.; Aprelev, M. V.; Zarubin, P. P.; Ioannu, P. D.; Orlov, B. N.; Romanov, V. S. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2648-2656(Dec 1972). (In Russian).

The scattering of protons by ^{53}Cr and the γ rays emitted during deexcitation of the excited states of this nucleus were studied. Angular distributions of protons corresponding to the excited levels of ^{53}Cr up to an energy of 3.153 MeV were measured. The results were analyzed in the framework of the optical model, the distorted-wave method, and Hauser−Feshbach theory. (6 figures) (tr-auth)

4107 STUDY OF (d,p) REACTIONS ON ^{52}Cr, ^{54}Fe, AND ^{90}Zr WITH A TENSOR-POLARIZED DEUTERON BEAM. Rohrig, N.; Haeberli, W. (Univ. of Wisconsin, Madison). Nucl. Phys.; A206: No. 2, 225-244(1973).

Measurements of the three tensor analyzing powers, T_{20}, T_{21}, and T_{22}, and the cross section for (d,p) reactions on ^{52}Cr, ^{54}Fe, and ^{90}Zr were made at a deuteron energy of 10.0 MeV for eighteen strong transitions with l = 0 to 4 in the angular range from 5° to 130°. The measurements are not explained by DWBA calculations which neglect the deuteron D state; in particular, calculated values of T_{21} are much smaller than the measurements. If the D state is included, the calculations reproduce the measurements at forward angles. (10 figures, 4 tables) (auth)

4108 $1f_{\frac{7}{2}}$ NUCLEI: SPHERICAL SHELL-MODEL STATES OF HIGH ANGULAR MOMENTUM IN ^{45}Sc, ^{45,47}Ti, ^{49}V, AND ^{49,51}Cr. Sawa, Z. P. (Research Inst. for Physics, Stockholm); Blomqvist, J.; Gullholmer, W. Nucl. Phys.; A205: No. 2, 257-291(1973).

A number of high spin states of negative parity were assessed for ^{45}Sc, ^{45}Ti, ^{47}Ti, ^{49}V, ^{49}Cr and ^{51}Cr, the six nuclei in the middle of the $1f_{\frac{7}{2}}$ shell. From observations on ^{42}Ca(α,p), ^{42}Ca(α,n), ^{44}Ca(α,n), ^{46}Ti(α,p), ^{46}Ti(α,n) and ^{48}Ti(α,n) at incident energies between 10.2 and 14.2 MeV, properties of these states were derived from studies of prompt γ-ray decay of the corresponding residual nuclei. Measuring p-γ and γ-γ coincidences, yields, angular distributions and linear polarizations of transitions states were assigned as follows (c = confirmed, energies are in keV): ^{45}Sc: 1237 $11/2^-$ (c), 1662 $9/2^-$ (c), 2107 $15/2^-$, 3160 ($13/2$ or $15/2$); ^{45}Ti: 1354 $9/2^-$ (c), 1469 $11/2^-$ (c), 2656 ($13/2$ or $15/2$), 3016 ($13/2$ or $15/2$); ^{47}Ti: 159 $7/2^-$ (c), 1253 $9/2^-$ (c), 1445 $11/2^-$ (c), 2672 $13/2^-$, 2683 $11/2^-$, 2749 $15/2^-$, 3289 $13/2^-$, 3571 $17/2^-$, 3984 (no spin proposed); ^{49}V: 1021 $11/2^-$ (c), 1155 $9/2^-$ (c), 2261 $15/2^-$, 2666 ($9/2$ or $11/2$), 2724 ($13/2^-$ or $15/2^-$), 3129 ($9/2^-$ or $11/2^-$ or $13/2^-$); ^{49}Cr: 271 $7/2^-$ (c), 1082 $9/2^-$ (c), 1561 $11/2^-$ (c), 2498 $13/2^-$, 3187 ($11/2^-$ or $13/2^-$ or $15/2^-$); ^{51}Cr: 749 $3/2^-$ (c), 1165 $9/2^-$ (c), 1353 $5/2^-$ (c), 1480 $11/2^-$ (c), 1557 $7/2^-$ (c), 2256 $15/2^-$, 2311 $7/2^-$ (c), 2386 $13/2^-$, 2704 ($5/2^-$ or $7/2^-$), 3180 ($15/2$ or $17/2$), 3262 ($9/2$ or $11/2$), 3448 $13/2^-$. Comparison with available model predictions revealed that the coupling schemes assuming pure $1f_{\frac{7}{2}}^n$ configurations which have been proposed for ^{45}Sc, ^{45}Ti, ^{47}Ti, ^{49}V and ^{51}Cr by McCullen, Bayman and Zamick, and for ^{49}Cr by Ginocchio account rather successfully for the excitation energies of states. However, evidence was found for configuration mixing. (auth)

4109 DEFORMED STATES IN ^{46}Sc. Dracoulis, G. D.; Durell, J. L.; Gelletly, W. (Univ. of Manchester, Eng.). J. Phys., A (London); 6: No. 4, L41-L44(Apr 1973).

The lifetimes of the low-lying negative-parity states in ^{46}Sc have been measured using the Doppler-shift attenuation method. The E2 transition strengths determined from these lifetimes are enhanced and confirm a suggestion that the 142.5 (1^-), 289.5 (2^-), 584.8 (3^-) and 1124.4 (4^-) keV states of ^{46}Sc form a rotational band based upon the $(f_{\frac{7}{2}})^7\ (d_{\frac{3}{2}})^{-1}$ configuration. (auth)

4110 EXPERIMENTAL TECHNIQUES IN NEUTRON SCATTERING. Meriel, P. (CEN de Saclay, Gif-sur-Yvette, France). Ann. Phys. (Paris); 7: No. 4, 255-268(Jul 1972).

A brief survey of the main experimental techniques associated with neutron diffraction (nuclear and magnetic) and inelastic neutron scattering is presented. (FR)

4111 BREAK-UP OF ^{6}Li AND ^{7}Li ON TIN AND NICKEL NUCLEI. Pfeiffer, K. O.; Speth, E.; Bethge, K. (Univ., Heidelberg). Nucl. Phys.; A206: No. 3, 545-557(1973).

The break-up of the stable lithium nuclei on ^{58}Ni and ^{118}Sn was investigated in the bombarding energy range 12 to 24 MeV. The emerging α particles were analyzed to show that the cross sections peak at the angle of grazing collisions. Inspection of the data suggests the conclusion that several different reaction mechanisms contribute to the continuous spectrum of the α particles. (auth)

4112 NEUTRON-INDUCED GAMMA-RAY PRODUCTION IN IRON FOR THE ENERGY RANGE $0.8 \le E_n \le 20$ MeV. Dickens, J. K.; Morgan, G. L.; Perey, F. G. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 50: No. 4, 311-336(Apr 1973).

Cross sections for production of gamma rays due to neutron interactions with iron have been measured as a function of both neutron and gamma-ray energy. Two experimental configurations were used to obtain the data: a NaI-spectrometer system using the Oak Ridge Linear Accelerator as the neutron source and a Ge(Li) spectrometer system using a pulsed Van de Graaff and the D(d,n) reaction as the neutron source. The NaI spectrometer system, described completely in this report, was used to acquire data for $0.8 \le E_n \le 20$ MeV and $\theta_\gamma = 125°$, which were unfolded to obtain $d^2\sigma/d\omega dE$ values for gamma-ray energies between 0.7 and 10 MeV. The Ge(Li) system was used to obtain high resolution information on the production of discrete-line $d\sigma/d\omega$ values for $4.85 \le E_n \le 9.0$ MeV and $\theta_\gamma = 55$, 75, and 90°. The data are compared with previously reported experimental data and with the current ENDF/B evaluation. Although there is generally reasonable (20%) agreement, important differences among these data are discussed. (auth)

4113 CHARGED PION PHOTOPRODUCTION ON ^{40}Ca NUCLEUS AT BREMSSTRAHLUNG MAXIMAL ENERGY 340 MeV. Grishaev, I. A.; Krinitsyn, A. N.; Lapin, N. I.; Nikiforov, V. I.; Pugachev, G. D.; Shramenko, B. I. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 445-450(Mar 1973). (In Russian).

Differential cross sections of charged pion photoproduction on ^{40}Ca nucleus are measured at the bremsstrahlung maximal energy E_θ = 340 MeV. π^+- and π^--mesons with kinetic energies from 20 to 90 MeV were registered using photoemulsions under 60°, 90°, and 120° angles. The π^-/π^+ ratio for kinetic energies from 25 to 85 MeV are found to decrease from 1.58 ± 0.3 to 0.9 ± 0.24, from 1.69 to 0.88 ± 0.26 from 1.82 ± 0.71 to 0.81 ± 0.3, for the 60°, 90° and 120° angles respectively. The experimental results are in agreement with volume production of charged mesons on nuclei. The equation for the calculation of the π^-/π^+ ratio is found. (auth)

4114 EXAMINATION OF THE γ DECAY OF THE ISOBARIC ANALOG STATES IN THE A > 40 MASS NUMBER RANGE. Fodor,

I. (Central Research Inst. for Physics, Budapest). Magy. Fiz. Foly.; 20: No. 5, 431-483(1972). (In Hungarian).

After a brief review of the theory of isobaric analog resonances, it is pointed out that in view of their simple structure and known configuration the isobaric resonance states are very useful for clarifying electromagnetic transitions in intermediate and heavy nuclei. The subject of the paper is the examination of the γ decay of the states in several nuclei of the $f_{\frac{7}{2}}$ and $p_{\frac{3}{2}}$ shells. The characteristics of such an M1 transition are evaluated by a qualitative model derived from the available experimental data, with the experimental basis and the calculations derived from the shell model also indicated. The general properties of electromagnetic transitions are reviewed, with emphasis on the role of the isospin in them. This is followed by an examination of the structure of the analog-antianalog states generated, the γ decay of the analog states, and the resulting nuclear spectroscopic conclusions. The study of the special M1 transitions in the s-d shell was extended to the $f_{\frac{7}{2}}$, $2p_{\frac{3}{2}}$ shells. The γ decay of analog states generated in (p,γ) reactions were investigated for ^{44}Ca, ^{48}Ti, and ^{58}Ni nuclei. (Candidate dissertation, 31 figures, 14 tables, 69 references.) (TTT)

4115 EMPIRICAL COLLECTIVE POTENTIALS OF ^{40}Ca AND ^{114}Cd. Bernus, L. V.; Schneider, U.; Greiner, W. (Univ., Frankfurt am Main). Lett. Nuovo Cim.; 6: No. 13, 527-535(31 Mar 1973 1973).

It is shown that a consistent quantitative description of the presently known low energy spectra of calcium-40 and cadmium-114 in terms of a collective-potential-energy surface with two minima can be achieved. The potential energy surfaces are constructed for these nuclei, and the spectra are shown. (JFP)

4116 SOME ACTIVATION CROSS-SECTIONS FOR 14.7 MeV NEUTRONS IN NICKEL. Hemingway, J. D. (Univ. of Durham, Eng.). J. Nucl. Energy; 27: No. 4, 241-246(Apr 1973).

The activation cross-sections for some fast neutron reactions on nickel have been determined. At 14.7 ± 0.2 MeV, values are as follows: ^{58}Ni(n,2n)^{57}Ni-32.6 ± 2.7 mb; ^{58}Ni(n,np + n,d + n,pn)^{57}Co-619 ± 49 mb; ^{58}Ni(n,p)^{58m,g}Co-349 ± 30 mb; ^{60}Ni(n,p)^{60m,g}Co-129 ± 16 mb. A comparison with previous values is given. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 2775, 3793, 4075, 4095, 4098, 4103, 4114, 4116, 4128, 4138, 4149, 4160, 4188, and 4204.

4117 (BNL-tr-532) DESCRIPTION OF A DIRECT (n,2n) REACTION OF SOME NUCLEI. Ezhov, S. N.; Ol'khovskii, V. S. Translated by S. J. Amoretty from Yadern. Fiz.; 16: No. 2, 332-334(1972). 6p. Dep. NTIS $3.00.

A type of excitation function for the (n,2n) reaction on ^{64}Zn is obtained within the framework of the direct knock-out model, and a comparison with experiment and with the analogous conclusion of statistical theory is conducted. On the basis of the results obtained the production cross section for a compound nucleus is calculated as a function of incident neutron energy. (1 figure) (auth)

4118 (CEA-R-4437) γ RAYS EMITTED BY SOME FISSION KRYPTONS AND XENONS AND THEIR DAUGHTER PRODUCTS. Blachot, J.; Carraz, L. C.; Marbach, O. (Commissariat A l'Energie Atomique, Grenoble (France). Centre D'Etudes Nucleaires). May 1973. 29p. (In French). Dep. NTIS (U. S. Sales Only) $3.50.

The γ-ray spectra following the decay of ^{91}Sr, ^{97}Kr, ^{98}Kr, ^{99}Rb, ^{138}Xe, ^{139}Cs were measured with a 43-cm^3 Ge(Li) detector, the resolution of which is 2.35 keV on the 1332-keV peak of ^{60}Co. The nuclides were separated by an on-line isotopic separation. The tables indicate the γ-ray energies with their error in keV, and their absolute intensities with their percent error. (6 figures, 8 tables) (auth)

4119 TRANSFER VS. COMPOUND NUCLEAR MECHANISMS IN THE REACTION OF HEAVY IONS WITH MEDIUM-MASS TARGETS. Williams, R. A. Pittsburgh; Carnegie-Mellon Univ. (1973). 132p. University Microfilms Order No. 73-9142.

Thesis (Ph. D.).

The mechanistic processes responsible for the production of nuclides removed from the completely fused system of target and heavy-ion projectile by several mass units are discussed. Excitation functions and average ranges were measured for the production of ^{66}Ga and ^{70}As from the reaction of ^{11}B and ^{12}C projectiles with targets composed of the separated isotopes of copper. In addition, angular and range distributions were determined for ^{12}C reactions with ^{63}Cu and ^{65}Cu. These quantities are each discussed in terms of their applicability to the delineation of reaction mechanisms. A computer program which simulates the evaporation of particles from a highly excited nucleus, a kinematic analysis of hypothetical reaction pathways, and a quasi-elastic scattering model which includes the effects of nucleon absorption are used in conjunction with the experimental measurements to propose mechanisms by which the observed nuclei, ^{66}Ga and ^{70}As, are produced from the separated isotopes of copper. (Diss. Abstr. Int., B)

4120 LOW LYING LEVELS OF ^{59}Co AND ^{59}Ni. Abuzeid, M. A.; El-Zaiki, M. I.; Youssef, A. A.; Saad, H. R. (Atomic Energy Establishment, Cairo). Atomki (At. Kut. Intez.) Kozlem.; 14: No. 4, 251-263(1972).

Angular distributions of gamma rays following the inelastic scattering of protons by ^{59}Co and from the reaction ^{59}Co(p,nγ)^{59}Ni were measured at proton energies below 2.50 MeV. Multipole mixing parameters for the 1.097-, 1.189-, and 1.289-MeV gamma rays in ^{59}Co and the transition 0.343 — 0 in ^{59}Ni were determined. Spin assignments for the above-mentioned states are suggested. The experimental results show a good agreement with the prediction of the statistical compound nucleus model. (7 figures, 1 table) (auth)

4121 STRUCTURE OF ^{59}Ni AND ROLE OF SIMPLE CONFIGURATIONS IN γ-TRANSITIONS FROM CAPTURE STATE IN ^{58}Ni(n,γ)^{59}Ni. Knat'ko, V. A.; Nelaeva, V. L; Rudak, E. A. (Inst. of Physics, Minsk). Yadern. Fiz.; 17: No. 2, 262-266(Feb 1973). (In Russian).

The spectrum of ^{59}Ni lower levels was calculated in the framework of intermediate approximation of a unified model. A good agreement with experiment was achieved. The wave functions of lower p-levels were used for estimation of probabilities of γ-transitions of EI type from capture state in ^{58}Ni(n,γ)^{59}Ni. (auth)

4122 SIMPLE EXPLANATION OF THE SIGN AND MAGNITUDE OF QUADRUPOLE MOMENTS IN EVEN-A Fe, Zn, Cd, Te, AND Hg ISOTOPES. Alaga, G. (Univ. of Copenhagen); Paar, V.; Lopac, V. Phys. Lett.; 43B: No. 6, 459-462(19 Mar 1973).

Coupling valence-shell protons (cluster) to the vibrational field gives the sign and magnitude of quadrupole moments in Fe, Zn, Cd, Te, and Hg as a consequence of the shell structure. Competition of contributions of the available valence proton configurations determines the sign and magnitude of the quadrupole moment of two-proton clusters. The field-induced polarization effect always leads to an enhancement of the cluster quadrupole moment. (auth)

4123 NEUTRON DISTRIBUTION IN NUCLEI FROM BREMSSTRAHLUNG: WEIGHTED CROSS SECTIONS. Leonardi, R. (Univ., Bologna). Phys. Lett., B; 43B: No. 6, 455-458(19 Mar 1973).

Bremsstrahlung-weighted cross-section (bwcs) measurements may be a decisive step to obtain information about the difference between neutron and proton radii. A model-independent relation is discussed between the total bwcs, the relative intensity of the bwcs of the upper ($T_>$) fragment of the dipole excitation and the neutron and proton radii. (auth)

4124 STUDY OF THE ^{59}Co(n,γ) REACTION WITH POLARIZED NEUTRONS AND POLARIZED NUCLEI. Reddingius, E. R. (Reactor Centrum Nederland, Petten); Bosman, J. J.; Postma, H. Nucl. Phys.; A206: No. 1, 145-163(1973).

Neutron capture γ rays following capture of polarized neutrons by polarized ^{59}Co nuclei were measured in the direction of nuclear orientation and perpendicular to this direction with parallel and antiparallel polarization directions of neutrons and nuclei. A hexagonal single crystal of cobalt and a Co-8% Fe single crystal were used as samples. These were cooled to about 0.05°K with a ^{3}He-^{4}He dilution refrigerator. The polarized neutron beam was obtained by Bragg reflection from a magnetized Co-Fe crystal. The ratios of capture in states with the two possible spins of the compound nucleus were measured for 19 primary transitions. Spins of several final levels were deduced from the anisotropies of primary transitions and also from the measured intensities of low-energy transitions. (5 figures, 3 tables) (auth)

4125 STUDY OF ^{74}As BY THE ^{73}Ge(^{3}He,d) REACTION. Rosner, B. (Technion-Israel Inst. of Tech., Haifa); Mordechai, S.; Pullen, D. J. Nucl. Phys.; A206: No. 1, 76-82(1973).

The energy levels of ^{74}As were studied using the ^{73}Ge(^{3}He,d)^{74}As reaction at an incident energy of 17 MeV. The overall energy resolution was 30 keV. Twenty-five levels in ^{74}As were identified up to 2.2 MeV excitation energy, and angular distributions were measured in the interval 3¾° to 86¼°. Spectroscopic strengths and l_p values were extracted for many of the transitions by means

of a distorted-wave analysis of the differential cross sections. A comparison with the ^{75}As(p,d) data suggests the presence of several unresolved doublets in ^{74}As. (3 figures, 2 tables) (auth)

4126 PROPERTIES OF THE ^{71}Ga NUCLEUS IN THE SHELL MODEL. Isakov, V. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 805-808(Apr 1972). (In Russian).

The $^{71}_{31}Ga_{40}$ nucleus was examined within the framework of the shell model with residual interaction between the 3 valance protons at the level of the intermediate field formed by the doubly magic $^{78}_{28}Ni_{40}$ core. It may be considered that the core becomes excited by the introduction of an effective charge e_{eff}, which is practically independent of the transition energy of ^{71}Ga. The value of e_{eff} is a parameter determined from the best agreement with experimental data. The study was limited to the lowest levels built on the ground state of the core. The transition probabilities, magnetic dipole moments, and electric quadrupole moments of the states were calculated. The experimental data agree with theory; therefore, the model used can be applied to study the properties of ^{71}Ga. (TTT)

4127 COULOMB EXCITATION OF THE NUCLEAR LEVELS OF ^{69}Ga AND ^{71}Ga. Andreev, D. S.; Grinberg, A. P.; Gusinskii, G. M.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz. 36: No. 4, 813-832(Apr 1972). (In Russian).

Following up earlier studies on the Coulomb excitation of gallium isotopes, examination of γ spectra was used to investigate the Coulomb excitation of the nuclear levels of ^{69}Ga and ^{71}Ga in order to determine the electric and magnetic transition probabilities. Alpha particles of 6 to 8 MeV, and in some control experiments 23-MeV nitrogen ions were used as bombarding particles, recording the γ radiation by a coaxial Ge(Li) detector. The experimental error was always kept below 10%, usually at about 5%. The experimental data were compared with calculated values of the level energies of ^{69}Ga and ^{71}Ga, using a model which takes the bond between the particle and the core into account, determining also the values of B(E2)↑, B(M1)↑, the quadrupole moment (Q_0), and the magnetic moments of the ground state. Previous data by R. S. Reehal and R. A. Sorensen were also included in the comparison. In case of the 574- and 1106-keV transitions, the experimental B(E2)↑ data differed from the authors' theoretical values by two orders of magnitude; the agreement with the Reehal data was better but it still amounted to an order of magnitude. This indicates that the model of the bond of the odd particles with the core cannot be used to describe the properties of the lower excited state of ^{69}Ga and ^{71}Ga. (TTT)

4128 INFLUENCE OF LOW-LYING COLLECTIVE STATES ON THE CHARACTERISTICS OF PHOTODISINTEGRATION OF INTERMEDIATE AND HEAVY NUCLEI. Akbari, M. Yu.; Erokhin, K. M.; Zhivopistsev, F. A.; Shitikova, K. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2540-2543(Dec 1972). (In Russian).

Characteristics of photodisintegration of the nuclei ^{60}Ni, ^{90}Zr, and ^{208}Pb were studied with regard to the influence of low-lying collective states. The spectra of photonucleons, cross sections of (γ,p) and (γ,n) reactions, and decay widths were evaluated. (2 figures, 1 table). (KSW)

4129 RADIATIVE CAPTURE OF PROTONS BY ^{64}Zn, ^{66}Zn, ^{68}Zn NUCLEI. Nemashkalo, B. A.; Storizhko, V. E.; Boldyshev, V. F.; Ekhichev, O. I.; Klyucharev, A. P.; Popov, A. I. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 17: No. 2, 229-233(Feb 1973). (In Russian).

Triple angular $\gamma\gamma$-correlations in ^{65,67,69}Ga nuclei were measured with semithick targets. The analysis was carried out in the framework of statistic theory. The spins of lower levels of ^{65,67,69}Ga as well as the mixing coefficients for γ-transition series were determined. (auth)

4130 STUDY OF LOW-LYING LEVELS IN ^{59}Ni. Hutton, J. D. (Duke Univ., Durham, NC); Roberson, N. R.; Gould, C. R.; Tilley, D. R. Nucl. Phys.; A206: No. 2, 403-416(1973).

Electromagnetic transition strengths for decays between low-lying levels in ^{59}Ni were studied with the ^{56}Fe(α,n)^{59}Ni reaction. Mean lifetimes of levels were measured by the Doppler-shift-attenuation method and the recoil-distance method. Level spins, mixing ratios, and branching ratios were investigated with the method of particle–γ-ray angular correlations. The following lifetimes are reported (level energy in keV, lifetimes in ps): 340 (120 ± 20), 465 (29 ± 5), 878 (0.62 ± 0.12), 1189 (0.44 ± 0.07), 1302 (0.18 ± 0.02), 1339 (1.28 ± 0.46), 1680 (0.42 ± 0.23), 1735 (0.18 ± 0.04), 1948 (0.20 ± 0.06). Electromagnetic transition strengths are extracted and compared with two recent shell-model calculations. (8 figures, 2 tables) (auth)

4131 ANALOGUE STATES IN ^{61}Cu. Trentelman, J. P.; Leslie, J. R.; McLatchie, W. (Queen's Univ., Kingston, Ont.). Nucl. Phys. A206: No. 2, 393-402(1973).

Resonances in the reaction ^{60}Ni(p,γ)^{61}Cu were studied in the energy region $E_p \approx 1550$ to 1950 keV. Decay schemes and branching ratios are presented for 12 resonances, and the resonance strength was determined for most of these. Gamma-ray angular distribution measurements on two resonances yield the following spin assignments (E_p(keV); J): (1668; $\frac{5}{2}$), (1850; $\frac{3}{2}$, $\frac{5}{2}$). Several of the resonances studied are identified as fragments of the analog states of the ground and first two excited states in ^{61}Ni. Strengths of M1 transitions to the corresponding antianalog candidates were measured. (3 figures, 3 tables) (auth)

4132 COULOMB EXCITATION OF ^{85}Rb AND ^{87}Rb. Bond, P. D.; Kumbartzki, G. J. (Stanford Univ., CA). Nucl. Phys.; A205: No. 2, 239-248(1973).

Energy levels of ^{85}Rb and ^{87}Rb were studied via de-excitation γ-rays following Coulomb excitation with ^{35}Cl ions. In addition to the known negative-parity states at 151.2 keV and 868.2 keV in ^{85}Rb, two states at 281.0 keV and 731.8 keV were found with four γ-ray transitions of 129.8, 281.0, 450.8 and 731.8 keV. Only one Coulomb excited state at 402.6 keV in ^{87}Rb was observed. The B(E2↑) values (in units $e^2 \cdot b^2$) were determined as 0.0035 ± 0.0004 (151.2 keV), 0.0016 ± 0.0002 (281.0 keV), 0.0101 ± 0.0010 (731.8 keV), and 0.036 ± 0.004 (868.2 keV) for the states in ^{85}Rb, and as 0.0054 ± 0.0006 (402.6 keV) for the state in ^{87}Rb. The mean lifetimes of the 731.8 keV and 868.2 keV states were measured by the Doppler shift attenuation method as 6.4 ± 0.7 psec and 4.2 ± 0.5 psec respectively. Angular distribution measurements allow unique spin and parity assignments of $\frac{1}{2}^-$ and $\frac{3}{2}^-$ to the 281.0 keV and 731.8 keV levels respectively. The spin and parity of the 868.2 keV level was restricted to $\frac{5}{2}^-$ or $\frac{7}{2}^-$. (auth)

4133 PARTICLE COUPLING TO THE OCTUPOLE STATE IN ^{89}Sr FROM ^{88}Sr(p,p')^{88}Sr ANALOG RESONANCES AND ^{88}Sr(d,p)^{89}Sr. Slater, D. C. (Massachusetts Inst. of Tech., Cambridge); Cosman, E. R.; Pullen, D. J. Nucl. Phys.; A206: No. 3, 433-451 (1973).

A study was made of the six most pronounced isobaric analog resonances in the ^{88}Sr(p,p')^{88}Sr(3^-) excitation function at E_p = 7.65, 7.80, 7.92, 8.78, 9.75, and 9.90 MeV. They are believed to have a simple structure in the parent nucleus, ^{89}Sr, consisting of the low-lying positive-parity, single-neutron spectrum of ^{89}Sr weakly coupled to the collective 3^- state in ^{88}Sr. A high-resolution ^{88}Sr(d,p)^{89}Sr experiment was performed to locate small 2f and 3p admixed fragments in ^{89}Sr which would allow these analog resonances their entrance widths. In addition, on-resonance ^{88}Sr(p,p')^{88}Sr(3^-) angular distributions were measured in order to determine the partial waves involved in the exit channel. Results are compared to a particle–phonon coupling model, and overall selectivity, strengths, and angular distributions of the (p,p') analog resonances are consistent with the above interpretation. (10 figures, 3 tables) (auth)

4134 ^{16,18}O AND ^{12}C INDUCED REACTIONS ON A = 40 TO 96 NUCLEI. Christensen, P. R.; Manko, V. I.; Becchetti, F. D.; Nickles, R. J. (Univ. of Copenhagen). Nucl. Phys.; A207: No. 1, 33-77(1973).

Elastic, inelastic, and one-, two-, three-, and four-nucleon-transfer reactions induced by ^{16,18}O and ^{12}C bombardment of target A = 40 to 96 nuclei were studied at incident energies well above the Coulomb barrier. The inelastic angular distributions showed structure correlated to that of the elastic scattering, while the transfer-reaction angular distributions were structureless. The transfer reactions, however, were found to populate selectively states in the final nucleus. A strong Q-value dependence was observed for all of the reactions studied. This dependence and the angular distributions are interpreted using classical and quantum mechanical (DWBA) models. (48 figures, 11 tables) (auth)

4135 ELASTIC SCATTERING OF 100- AND 200-keV POSITRONS BY SELENIUM AND BISMUTH. Kobayashi, T.; Shimizu, S. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 50: No. 5, 488-498(Sep 1972).

The differential cross sections for elastic scattering of positrons by ^{34}Se and ^{83}Bi targets were measured at 30°, 40°, 60°, and 85° for energies of 100 and 200 keV. Positron beams of these energies were obtained by the use of a sector-type double-focusing β-ray spectrometer mounted with a ^{22}Na source. Scattered positrons were measured by semiconductor (silicon) detectors in a scattering chamber. The experimental results were compared with the theoretical values calculated by the Mott phase-shift method. Though the experimental cross sections were, on the whole, in agreement with the theoretical values, the experimental cross sections tended to be lower than the theoretical ones, especially

in the case of 100-keV positron scattering by Bi targets. This phenomenon was considered to be due to the effect of local distortion of the electron cloud by the incident particle. (3 figures, 5 tables) (auth)

4136 GENERALIZED R-MATRIX INTERPRETATION OF THE ^{89}Y + n TOTAL CROSS SECTION AT LOW INCIDENT ENERGIES. Ramavataram, S.; Goulard, B.; Bergeron, J. (Univ. Laval, Quebec). Nucl. Phys.; A207: No. 1, 140-160(1973).

The resonance structure observed in the ^{89}Y(n,n)^{89}Y total cross-section measurements in the range of 0.9 to 1.2 MeV neutron energy is investigated using a comprehensive theory of nuclear reactions. A shell-model calculation, which formed the initial stage of this study, predicts satisfactorily the energies of the negative-parity states that contribute to the observed anomalies. The neutron decay widths for these resonances are evaluated using the model wave functions. The general trends in the energy dependence of the total cross section are satisfactorily reproduced by the theory. The factors that could contribute to the discrepancies between theory and experiment are discussed. The theoretical estimates of the damping widths for the two 1^- anomalies that occur in this region were within 20 to 25% of the experimental values, and support the view that these are intermediate-type resonances. Their configurational structure as predicted by the model calculation suggests that they are the parent states of the $T_>$ components of the giant dipole resonance near 21.0 MeV in ^{90}Zr. The distribution of E1 widths calculated for a proposed $1^- \rightarrow 2^+$ (at 0.78 MeV) transition in ^{90}Y indicates that an anomaly corresponding to these 1^- states can also be expected in the (n,γ) reaction. (5 figures, 4 tables) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 2381, 2441, 2728, 3793, 4057, 4097, 4107, 4111, 4115, 4118, 4122, 4123, 4128, 4134, 4136, 4178, 4188, 4204, 4222, 4263, 4270, 4276, and 4283.

4137 (LBL-1647) THEORETICAL STUDY OF TWO NUCLEON TRANSFER BETWEEN HEAVY IONS INCLUDING THE EFFECT OF INELASTIC PROCESSES. Glendenning, N. K.; Ascuitto, R. J. (California Univ., Berkeley. Lawrence Berkeley Lab.). Mar 1973. Contract W-7405-eng-48. 20p. (CONF-730312-7). Dep. NTIS $3.00.

From symposium on heavy-ion transfer reactions; Argonne, Illinois, USA (15 Mar 1973).

The reaction ^{120}Sn(^{18}O,^{16}O)^{122}Sn was studied at 100 MeV in an attempt to estimate the effects of higher-order processes on the cross sections for particle-transfer reactions at around 100 MeV. The source term method was used in the calculations. The inelastic transitions were computed on the basis of the macroscopic vibrational model, and recoil effects were neglected. The strength of the Coulomb quadrupole terms was determined by using the experimental value of B(E2). Conventional DWBA and coupled-channels calculations are shown for the ground and 2^+ states. Dependence of the cross sections on deformation parameters, Q value, and incident energy were investigated. Calculations in which the higher intermediate states are produced only by Coulomb excitation show that the coupling changes the 2^+ state most, by a 15% increase in cross sections at the grazing angle, as compared with the DWBA; this result is in marked contrast to a reduction in cross section by a factor of 4 when the nuclear excitation is included. It is concluded that the usual first-order treatment of heavy-ion transfer reactions is often inadequate and that inclusion of the higher-order processes involving the excitation of the target or residual nucleus is essential for a correct description. It is suggested that all collective states receive a large second-order contribution from the branches $O(A) \rightarrow J(A) \rightarrow J(A+2)$ and $O(A) \rightarrow O(A+2) \rightarrow J(A+2)$. The effect of the higher-order processes was to destroy the simple distribution, consisting of a peak at the grazing angle, that is expected from classical considerations. Moreover, the precise effect is a strong function of the collectivity of the intermediate state and also of the Q of the reaction. Because of the destructive interference between the direct and indirect amplitudes, the resulting angular distributions are expected to show considerable variation from level to level and nucleus to nucleus. (11 figures, 2 tables) (RWR)

4138 (LYCEN-7241) PROTON EMISSION SPECTRA IN α INDUCED NUCLEAR REACTIONS AT 54.8 MeV. De-Excitation Before Statistical Equilibrium is Reached. Tran Minh Duc (Lyon Univ. (France). Institut de Physique Nucleaire). Jul 1972. 78p. (In French). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis.

The differential cross sections for the emission of protons during interactions between 54.8-MeV α particles and ^{51}V, ^{56}Fe, ^{59}Co, ^{63}Cu, ^{65}Cu, ^{66}Zn, ^{93}Nb, ^{107}Ag, ^{109}Ag, ^{115}In, ^{116}Sn, ^{181}Ta, and ^{197}Au were measured. In the (α,p) spectra obtained, the components characteristic of two reaction mechanisms were observed: the first reaction has a low emission energy and corresponds to an evaporation process; the second reaction, occurring at a higher energy, corresponds to an angular distribution strongly concentrated in the forward direction and having a cross section relatively insensitive to the mass number, this reaction being attributed to an emission process occurring prior to the establishment of a statistical equilibrium. A theoretical analysis of the experimental results in the framework of a formalism involving the de-excitation of the compound nucleus, before the complete establishment of a statistical equilibrium, yields satisfactory results. (FR)

4139 ISOBARIC SPIN MIXING IN THE ANALOG STATES OF ^{90}Zr. Askin, H. J.; Hicks, R. S.; Allen, K. J. F.; Petty, R. J.; Thompson, M. N. (Univ. of Melbourne, Parkville, Australia). Nucl. Phys.; A204: No. 1, 209-219(1973).

A 90° photoproton energy spectrum was obtained from the reaction ^{90}Zr(γ,p)^{89}Y by using an isotopically enriched target foil. Previously unreported proton groups were observed at E_p = 6.95, 9.55, 10.68, and 11.03 MeV. A total photoneutron cross section and a low-energy neutron energy spectrum are also presented, and isospin mixing is demonstrated by comparison with the photoproton data. The possibility of $T_>$ strength in the region 23 to 24 MeV excitation is noted. (5 figures, 1 table) (auth)

4140 STUDY OF THE ^{138}Ba(d,p)^{139}Ba REACTION AT 19 MeV. Ipson, S. S.; Booth, W.; Haigh, J. G. B. (Univ. of Bradford, Eng.). Nucl. Phys.; A206: No. 1, 114-130(1973).

The ^{138}Ba(d,p) reaction was studied at an incident deuteron energy of 19 MeV by using the injector–tandem accelerator and the multichannel magnetic spectrograph of the University of Oxford. Deuteron and proton optical-model parameters were obtained from the analysis of elastic scattering experiments on a ^{138}Ba target. The parameters were used to calculate theoretical (d,p) angular distributions on the basis of the DWBA. From the comparison of experimental and theoretical distributions, orbital angular momentum transfers were deduced and spectroscopic factors, determined for all the levels observed up to an excitation energy of 2.5 MeV in ^{139}Ba. The spectroscopic information thus obtained is more extensive than that from previous studies, and is in satisfactory agreement with expected sum rule limits. A notable item of new information is the assignment of an $l_n = 6$ transition to the level at 1.54 MeV in ^{139}Ba. (6 figures, 3 tables) (auth)

4141 EXCITATION OF THE LEVELS OF THE ^{105}Pd NUCLEUS IN THE (α,3n) REACTION. Grigor'ev, E. P.; Zolotavin, A. V.; Sergeev, V. O.; Ride, Kh. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 767-76(Apr 1972). (In Russian).

Following up earlier studies of the excited levels of ^{105}Pd up to 1100 keV, the γ-ray spectra of ^{104,105,106}Pd, obtained with Ge(Li) detectors by irradiating ^{104}Ru with 26 to 43 MeV α particles, were investigated. The data on the ^{104}Pd and ^{106}Pd spectra have been published previously. The γ transitions of ^{105}Pd were tabulated, indicating their intensities with respect to $I_{\gamma 306.2}$, averaged at angles of 90°, 125°, and 150° with respect to the direction of the 32-MeV α particle beam. The 306.2-keV γ rays correspond to the de-excitation of the first excited level. The isotope in which the γ transition occurred was identified by the intensity ratios at α-particle energies of 26, 32, and 43 MeV. The intensities of the strongest transitions from each of the known levels of ^{105}Pd were estimated, studying thereby the population of these states in the (α,3n) reaction. The angular distributions for E_α = 32 MeV were analyzed for each high-intensity transition. The distribution of the 182.7-keV γ rays was found to be isotropic, but the corresponding peak was covered up by the 182-keV line from the γ transition of ^{18}F, complicating the determination. (TTT)

4142 ENERGY OF ^{140}Nd → ^{140}Pr DECAY. Baier, G. Yu.; Butsev, V. S.; Gromov, K. Ya.; Kalinnikov, V. G.; Mortensen, K. O.; Nilssen, G. L.; Tikhonov, N. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 782-785(Apr 1972). (In Russian).

In the allowed β decay of nuclei in the A ~ 140 range, Gamow–Teller type transformations take place between the states of the spin orbital doublet. The effect of pair correlations on the β process was investigated in the ^{140}Nd → ^{140}Pr → ^{140}Ce decay chain. Measurement of the total intensity of the K lines of ^{140}Pr and ^{140}Ce and knowledge of the K-capture probability of ^{140}Pr allowed the determination of K-capture ratio in the electron capture of ^{140}Nd. This ratio is a single-valued function of the transition energy. The x-ray spectrum of ^{140}Nd + ^{140}Pr was measured on the semi-

conductor spectrometer of the Aarhus (Denmark) University. The K-capture ratio in the electron capture of ^{140}Nd was found to be $(W_K/W_\epsilon)_{exp.} = 0.745 \pm 0.048$; the energy of the ^{140}Nd → ^{140}Pr decay was calculated to be $Q_\epsilon = 131^{625}_{\overline{75}}$ keV. The β transition between the ground states of ^{140}Nd and ^{140}Pr is characterized by log ft = 4.18^{+48}_{-30}. (TTT)

4143 EXCITED STATES OF ^{139}Pr. Krupa, E.; (Joint Inst. for Nuclear Research, Dubna, USSR); Morozov, V. A.; Muminov, T. M.; Razov, V. I.; Fuya, Kh.; Khalikulov, A. B. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 777-781(Apr 1972). (In Russian).

The γ-γ angular correlations in the 114-708 and 114-738 cascades of ^{139}Pr, originating in the decay of the isomeric state of ^{139}Nd, were investigated. The goal of the study was to determine the spin of certain excited levels and the actual value and the sign of multipolarities of the transitions. The γ-γ angular correlations were studied by means of an automated spectrometer with a coaxial semiconductor Ge(Li) detector and an NaI(Tl) scintillation spectrometer in its channels, at angles of 90°, 135° and 180°. The ^{139*}Nd source was separated from the neodymium fraction, obtained by chromatography from a gadolinium target irradiated with 660-MeV protons. The lifetime of the 822-keV state determined by coincidence measurements was found to be $T_{\frac{1}{2}} = 36.8 \pm 2.0$ nsec, which agrees within limits of experimental error with the value reported by W. H. Kelly et al. The M2 and E3 transition probabilities de-exciting the ^{139}La, ^{139}Pr, and ^{141}Pm (N = 80) levels were analyzed. The 825-keV, $11/2^+$ level of ^{139}Pr is believed to be a member of the (G 7/2, 2^+) multiplet. (TTT)

4144 SPLITTINGS OF THE OCTUPOLE STRENGTH IN Te ISOTOPES. Matoba, M. (Kyushu Univ., Fukuoka); Hyakutake, M.; Nakamura, S.; Katayama, T.; Tonai, T.; Yagi, K.; Sato, K.; Aoki, Y. Phys. Lett.; 44B: No. 2, 159-160(16 Apr 1973).

In the (p,p′) reaction on ^{130}Te, strong excitation of the second 3^- state was found at 3.36 ± 0.01 MeV excitation energy. No second 3^- state was observed in the (p,p′) reaction on ^{126}Te. (auth)

4145 INTERNAL CONVERSION IN THE N-SHELL FOR M4 TRANSITIONS OF ^{121,123,125,127,129}Te. Kalinauskas, R. A.; Makaryunas, K. V.; Davidonis, R. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2518-2519(Dec 1972). (In Russian).

The ratios (N + O)/L for M4 transitions in the nuclei ^{121,123,125,127,129}Te were determined with a β spectrometer. The experimental ratios (N + O)/L were contrasted with the theoretical N/L values obtained from a combination of L-shell internal conversion ratios of Hager and Seltzer with the extrapolations to Z = 52 of the N-shell internal conversion ratios of Dragoun-Pauli-Schmutzler. (tr-auth)

4146 COULOMB EXCITATION OF THE NUCLEAR LEVELS OF ^{93}Nb. Andreev, D. S.; Grinberg, A. P.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh.; Chugunov, I. N. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 809-817(Apr 1972). (In Russian).

The Coulomb excitation of ^{93}Nb was investigated in order to obtain information about its level scheme, considering the electromagnetic transition probabilities, and to obtain more precise data than heretofore obtained. The results of the level scheme calculations of ^{93}Nb and the electromagnetic transition probability calculations were compared on the basis of a model assuming an intermediate bond of the valence proton with the ^{92}Zr core. The Coulomb excitation levels were studied by recording the γ spectra emitted when a thick metallic niobium target was bombarded with 8.6 and 9.4 MeV α particles, using a Ge(Li) detector. The electromagnetic transition probabilities obtained were tabulated. The quadrupole moment of the first excited state of ^{92}Zr was also calculated, but this value was not determined experimentally. Lack of knowledge of the quantum characteristics of the levels of ^{93}Nb rendered difficult the comparison of calculated B(E2) values with experimental data. (TTT)

4147 QUANTUM CHARACTERISTICS OF SOME LEVELS OF ^{135}La. Zeuk, V. (Marie Sklodowska-Curie Univ., Lublin); Krupa, E.; Morozov, V. A.; Muminov, T. M.; Fuya, Kh.; Khalikulov, A. B. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 753-766(Apr 1972). (In Russian).

In order to obtain more accurate data on the spin of excited levels and multipole transitions of ^{135}La, the angular correlations of the 576-206, 664-206, 605-265, and 571-300 keV transitions were determined. A ^{135}Ce source, obtained by the spallation reaction of gadolinium irradiated with 660-MeV protons, followed by chromatographic separation, was used for the experiments. The results of measurements lead to the conclusion that the 206-keV M1 transitional level is characterized by $5/2^+$. This finding agrees with the decay scheme of ^{135}Ce; no decay to the 206-keV level was observed. The multipolarity determined by the angular correlation of the 576-keV transition was M1 + (12.0 ± 0.8)% E^2 or nearly pure E^2. No conclusion could be drawn for the 664-keV transition. Calculations of the matrix elements, assuming Gamov-Teller or Fermi type transitions to the 265-keV level in the decay of ^{135}Ce, may help to clarify the nature of this transition. (TTT)

4148 DECAY ^{135}Pr → ^{135}Ce. Arl't, R. (Joint Inst. for Nuclear Research, Dubna, USSR); Baier, G.; Morozov, V. A.; Muziol, G.; Muminov, T. M.; Tyrroff, Kh.; Shtrusnyi, Kh.; Usmanova, Z. A.; Fominykh, V. I.; Fuya, Kh.; Khalikulov, A. B.; Kherrmann, E. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 744-752(Apr 1972). (In Russian).

The decay scheme of ^{135}Pr → ^{135}Ce is of great interest because the $^{135}_{58}$Ce nucleus is in the transition region between the "spheric" nuclei N ≅ 82 and the highly neutron-deficient, deformed nuclei. The study helped to clarify contradictory data in the earlier literature and yielded a new decay scheme containing 15 excited states. The neutron-deficient praseodymium isotopes were prepared by exposing the $(NH_4)_2(GdDTPA) \cdot H_2O$ complex to a 660-MeV proton beam of the synchrocyclotron. The γ spectra were measured by means of coaxial Ge(Li) detectors; a computer program was used to detect the $\gamma\gamma$ coincidences. The data were used to derive the decay scheme of ^{135}Pr; 12 of the 15 excited states were reported for the first time; 9 of them were confirmed by $\gamma\gamma$ coincidences. The data lead to the conclusion that there are two levels with an energy of about 296.12 keV within an energy range of less than 100 eV. In case of the de-excitation of the isomeric ^{135*}Ce state probably only one becomes excited; its de-excitation is characterized by intense cascade transitions and by relatively low-probability transitions to the ground state. The β^+ decay of ^{135}Pr populates both levels, but the second one is de-excited by a high-intensity transition to the ground state. The higher 620.9, 697.5, 780.2, 806.9, 1016 and 1834.0 keV levels were found by $\gamma\gamma$ coincidence measurements and by the energy balance and intensity of transitions; the 1367.5, 1728, 1951 and 2020 keV level only by energy balance and γ transition measurements. The lifetime of the 82.64-keV state of ^{135}Ce was found to be $T_{\frac{1}{2}} = (0.33 \pm 0.06)$ nsec. (TTT)

4149 E1 TRANSITIONS BETWEEN LOWER STATES OF ODD-ODD NUCLEI. Rozantsev, I. N.; Estulin, I. V. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2533-2539(Dec 1972). (In Russian).

E1-transition data between states of odd-odd spherical and deformed nuclei with energies up to ~1 MeV are tabulated together with measured lifetimes. The configurations of the odd-odd nucleus states are postulated on the basis of data on neighboring odd nuclei. (1 figure, 2 tables) (KSW)

4150 EXCITED STATES OF ^{109,111,115,117}In STUDIED BY THE ANTICOINCIDENCE METHOD. Burmistrov, V. R.; Shilin, V. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2499-2508(Dec 1972). (In Russian).

The decay of the isotopes ^{109}Sn, ^{111}Sn, ^{115}Cd, and ^{117}Cd was investigated by the anticoincidence methods and quantitative analysis of the energies and intensities of γ transitions. Energy-level diagrams are presented for ^{109}In, ^{111}In, and ^{117}In. (3 figures, 3 tables) (tr-auth)

4151 EXCITED STATES OF ^{115,117,119}Sb STUDIED BY THE ANTICOINCIDENCE METHOD. Shilin, V. A.; Burmistrov, V. R. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2509-2517(Dec 1972). (In Russian).

The decay of the isotopes ^{115}Te, ^{117}Te, and ^{119}Te was investigated by the methods of nuclear spectroscopy and anticoincidences with quantitative analysis of energies and relative intensities of γ transitions. The energy levels of ^{115}Sb, ^{117}Sb, and ^{119}Sb are diagrammed. (3 figures, 4 tables) (tr-auth)

4152 ANGULAR CORRELATION OF γ-RADIATION OF NEUTRON-RICH XENON ISOTOPES. Begzhanov, R. B.; Kobilov, O. Sh.; Sabirov, Kh. S.; Salimov, S. Kh.; Khudaibergenov, U. Kh. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2520-2525(Dec 1972). (In Russian).

The angular correlation of cascade γ quanta in ^{131,132,133,134,135}Xe was investigated. On the basis of the angular correlation coefficients A_2 and A_4 obtained, the spins of a large number of high-lying levels and the multipole orders of radiative transitions were established. (2 figures, 1 table) (tr-auth)

4153 STRUCTURE OF EXCITED LEVELS OF ODD ISOTOPES OF IODINE. Sinclair, D.; Kastel, B.; Johnston, I. P.; Yuan, J. T. (Queen's Univ., Kingston, Ont.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2526-2530(Dec 1972). (In Russian).

A model based on a Hamiltonian was developed and used to

compute all energy levels for ^{127}I below 900 keV. Spectroscopic factors for one-particle transfer reactions were calculated for ^{127}I and compared with the experimental data of Auble, Ball, and Fulmer [Phys. Rev., 169, 955 (1968)]. (2 figures, 2 tables) (KSW)

4154 LEVEL STRUCTURE OF THE N = 81 AND 82 NUCLIDES ^{137,138}Ba AS INVESTIGATED IN ^{136}Xe(α,xn) REACTIONS. Kerek, A.; Kownacki, J. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A206: No. 2, 245-272(1973).

Alpha-particle irradiation of the enriched gaseous target ^{136}Xe was used to populate states in the N = 81 and 82 nuclides ^{137}Ba and ^{138}Ba. Singles γ-ray spectra, angular distributions, $\gamma-\gamma$ coincidence spectra as well as time distributions with respect to the α-beam bursts were measured at various bombarding energies. From the observed Doppler shift for some transitions an upper limit for their half-lives ($T_{\frac{1}{2}} \leq 70$ ps) could be deduced. In ^{138}Ba, besides the 1435.9-keV 2^+ state, the 1898.7-keV 4^+ state, and the 2090.2-keV 0.8-μs 6^+ isomeric state observed in the radioactive decay, several high-spin, high-lying (≈4 MeV) states were populated. In ^{137}Ba states were observed up to ≈3 MeV excitation energy, among them a newly introduced isomeric state at 2349.1 keV with possible spins ($15/2^-$, $17/2^-$, $19/2^-$). This level, which has $T_{\frac{1}{2}}$ = 0.59 ± 0.10 μs, decays via a (120.2-1567.3 keV) γ-ray cascade to the well-known 2.55-min $11/2^-$ isomeric state at 661.6 keV energy. The energy spacing of ^{138}Ba is compared with theoretical predictions using δ forces. The levels of the neutron-hole nucleus ^{137}Ba are discussed in terms of 2p-1h and hole-vibration interactions. (12 figures, 5 tables) (auth)

4155 GAMMA TRANSITIONS BETWEEN LOW-LYING LEVELS IN ^{119}Sn. Raman, S. (Oak Ridge National Lab., TN); Stelson, P. H.; Slaughter, G. G.; Harvey, J. A.; Walkiewicz, T. A.; Lutz, G. J.; Multhauf, L. G.; Tirsell, K. G. Nucl. Phys.; A206: No. 2, 343-352(1973).

Measurements on the decay of ^{119}In isomers and the ^{118}Sn(n,γ) reaction were carried out to supplement Coulomb excitation measurements on ^{119}Sn. In addition to the 311.39-keV isomeric transition in ^{119}In, 13 γ rays were observed in ^{119}Sn from the decay of the 2-min and 18-min ^{119}In isomers. These γ rays were incorporated into a level scheme of ^{119}Sn with levels at 0, 23.867, 89.54, 787.01, 920.5, 921.4, 1089.5, 1187.76, 1249.67, 1304.44, and 1354 keV. Conclusive evidence for the existence of a 920.5-921.4 keV, $3/2^+-5/2^+$ level doublet was obtained from capture γ-ray measurements of resonance energy neutrons. (4 figures, 1 table) (auth)

4156 NUCLEAR ORIENTATION OF ^{110m}Ag IN IRON AND NICKEL. Johnston, P. D.; Stone, N. J. (Oxford Univ.). Nucl. Phys.; A206: No. 2, 273-287(1973).

The measurement of the hyperfine interactions at ^{110m}Ag nuclei in iron and nickel host lattices by nuclear magnetic resonance on oriented nuclei has enabled the γ-ray anisotropies measured by nuclear orientation to be interpreted in terms of the decay multipolarities. Results for M1/E2 mixing ratios are discussed in terms of deviations from a collective vibrational model for ^{110}Cd. (7 figures, 2 tables) (auth)

4157 TRANSITION PROBABILITY MEASUREMENTS IN ^{132}Te: THE SYSTEMATICS OF E2 TRANSITION RATES IN NEUTRON RICH EVEN Te NUCLEI. McDonald, J. (Swedish Research Council's Lab., Studsvik); Kerek, A. Nucl. Phys.; A206: No. 2, 417-426(1973).

Levels in ^{132}Te were populated in the 2.8- and 4.2-min β decays of ^{132}Sb, produced using the OSIRIS on-line isotope separator. The half-lives of the 1774-keV 6^+ and 1925-keV 7^- states in ^{132}Te were studied using the delayed coincidence method. Conversion coefficients were measured for the 151-keV $7^- \rightarrow 6^+$ E1 and the 103-keV $6^+ \rightarrow 4^+$ E2 transitions. The $T_{\frac{1}{2}}$ for the 6^+ state was deduced to be 145 ± 8 ns, which implies that B(E2; $6^+ \rightarrow 4^+$) = 132 ± 8 $e^2 \cdot fm^4$. The $T_{\frac{1}{2}}$ for the 7^- state was determined to be 9 ± 2 μs, giving a hindrance factor of 1.2×10^8 compared to the Weisskopf estimate. The result is interpreted in terms of two-particle configurations: $\nu(h_{11/2}^{-1}, d_{3/2}^{-1})_{7^-}$ and $\pi(g_{9/2}^2)_{6^+}$. The systematics of E2 transition rates in neutron-rich even tellurium isotopes are discussed, and comparison is made with available microscopic and macroscopic theories. (6 figures, 2 tables) (auth)

4158 ELASTIC AND INELASTIC SCATTERING OF POLARIZED DEUTERONS BY ^{120}Sn AT 28.6 MeV. Perrin, G.; Nguyen Van Sen; Arvieux, J.; Perrin, C.; Darves-Blanc, R.; Durand, J. L.; Fiore, A.; Gondrand, J. C.; Merchez, F. (Institut des Sciences Nucleaires, Grenoble, France). Nucl. Phys.; A206: No. 3, 623-632(1973).

Angular distributions of the differential cross section and of the vector and tensor analyzing powers were measured for the elastic scattering of 28.6-MeV polarized deuterons by ^{120}Sn. The data could be fitted satisfactorily by optical-model calculations. The agreement with the experimental values of the tensor quantity $T_{22} - (\sqrt{3}/2)T_{20}$ was improved by inclusion of a tensor term T_R in the optical potential. Cross sections and vector analyzing powers were also measured for the inelastic scatterings from the 1.18-MeV (2^+) and 2.44-MeV (3^-) states. An acceptable description of the data was obtained by coupled-channels calculations in the framework of the vibrational model. (5 figures, 1 table) (auth)

4159 PROPERTIES OF THE 2′ AND 2″ STATES IN ^{106,112,114}Cd. Grabowski, Z. W.; Robinson, R. L. (Oak Ridge National Lab., Tenn.). Nucl. Phys.; A206: No. 3, 633-640(1973).

Angular correlations were measured between γ rays from the $2 \rightarrow 2 \rightarrow 0$ cascades in ^{106,112,114}Cd and the beam of 11.0-MeV α particles effecting Coulomb excitation. Multipole admixtures for the $2 \rightarrow 2$ transitions, as deduced from these correlations, when combined with earlier results establish their B(E2) and B(M1) values. For the transitions from the 1312- and 1208-keV states in ^{112,114}Cd the B(E2) values in single-particle units are 18 ± 4 and 24 ± 7. These values are typical for transitions from "two-quadrupole-phonon" states in this mass region, whereas the B(E2) value of the 1718-keV transition in ^{106}Cd has the smaller value of 7.0 ± 2.3. The B(E2) values of the $2'' \rightarrow 2$ transitions in ^{112,114}Cd from the 1468- and 1363-keV states are <0.3 single-particle units. The B(M1) values of all five transitions are $\approx 10^{-2}$ $(e\hbar/2Mc)^2$. (7 figures, 2 tables) (auth)

4160 EXCITATION FUNCTION FOR HIGH-ENERGY (p,2p) REACTIONS. Das, S. (Univ. of Calcutta); Gupta, B. K.; Biswas, M. M. Nucl. Phys.; A206: No. 3, 573-582(1973).

The excitation functions of the (p,2p) reaction cross sections for the elements ^{25}Mg, ^{30}Si, ^{57}Fe, ^{68}Zn, ^{118}Sn, ^{142}Ce, and ^{186}W were calculated in the energy region above 100 MeV. The calculated values are compared with the available experimental results, and the agreement between the two is found to be fairly good. The dependence of $\sigma_{(p,2p)}$ on the target mass number is explained in terms of the expression derived. (6 figures, 8 tables) (auth)

4161 VECTOR ANALYSING POWER AND CROSS SECTION FOR ^{90}Zr(d⃗,p)^{91}Zr AT 11 AND 12 MeV. Rathmell, R. D.; Bjorkholm, P. J.; Haeberli, W. (Univ. of Wisconsin, Madison). Nucl. Phys.; A206: No. 3, 459-476(1973).

Angular distributions of the vector analyzing power and the cross section were measured for ^{90}Zr(d⃗,p)^{91}Zr. Measurements were made on two transitions at a deuteron energy of 11 MeV and on 20 transitions at 12 MeV. The observed j dependence of the vector analyzing power provided unambiguous spin assignments for most final states. Measurements of the cross section and vector analyzing power were also made for deuteron elastic scattering at 11 MeV in order to determine the potential parameters for DWBA calculations. The DWBA predictions are in good agreement with the measured (d,p) cross sections and in qualitative agreement with the analyzing powers. (9 figures, 4 tables) (auth)

4162 INTERNAL BREMSSTRAHLUNG ACCOMPANYING UNIQUE β-TRANSITION OF ^{137}Cs. Batkin, I. S.; Smirnov, Yu. G. (Voronezh State Univ., USSR). Yadern. Fiz.; 16: No. 4, 725-728 (Oct 1972). (In Russian).

The internal bremsstrahlung spectrum of once forbidden unique β-transition of ^{137}Cs was measured at 90° angle between the direction of the leaving electron and γ-quantum. A comparison with theoretical calculations with account of "roundabout" transitions was carried out. (auth)

4163 FORM OF HEAVY NUCLEUS SURFACE. Yushkov, A. V. (Inst. of Nuclear Physics, Alma-Ata, USSR). Yadern. Fiz.; 16: No. 4, 677-680(Oct 1972). (In Russian).

From the experimental angular distributions of elastic and inelastic diffraction scattering of α-particles the signs for equilibrium deformation of heavy nuclei were found for A = 92-176. The regularities in changing the surface form from a nucleus to nucleus are studied. (auth)

4164 ENHANCEMENT OF TWO-PHOTON TRANSFER IN N = 82 NUCLEI. A Study of 1p, 2p, and (2p + 2n) Transfer Reactions Induced by ^{16}O on ^{140}Ce, ^{142}Nd, and ^{144}Sm near the Coulomb Barrier. Von Oertzen, W. (Univ. of California, Berkeley); Bohlen, H. G.; Gebauer, B. Nucl. Phys.; A207: No. 1, 91-112 (1973).

One-proton, two-proton, and α-particle transfer were studied on nuclei with the closed neutron shell N = 82 by using ^{16}O beams of 63 to 66.5 MeV incident energy. Transfer probabilities defined in a semiclassical model are derived for the different reaction channels. For this purpose the Q value and angular dependence of the cross section are discussed. The two-proton transfer to the ground states shows an enhancement by a factor of 20 to 25 compared with other nuclei, this result showing the effect of the proton pairing in these nuclei (they correspond to equivalent neutron con-

figurations in ^{108,110,112}Sn). The total transfer probability follows a common trend for all three target nuclei as a function of energy above the Coulomb barrier for the proton and two-proton transfer, but not for the four-nucleon transfer. (12 figures, 2 tables) (auth)

4165 FISSION OF EMULSION NUCLEI AT HIGH ENERGY DISINTEGRATION. Deka, G. C.; Talukdar, G. N. (Cotton Coll., Gauhati, India). J. Assam Sci. Soc.; 13: 84-86(1970).

In a systematic search for nuclear fission, 1151 disintegrations initiated by 17.2-GeV/c π^--mesons were examined closely. Of these 80 stars were found having their prongs anisotropically distributed. In some of these the anisotropy was so much that a star took a clear dumb-bell shape, leading to the belief of "two center" production mechanism of the evaporated particles, this means that the struck nucleus first undergoes fission, and then these fragments evaporate the secondary particles. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 3793, 3951, 4057, 4061, 4138, 4149, 4160, 4163, 4222, 4246, 4256, and 4285.

4166 (LBL-1675) MOESSBAUER ISOMER SHIFTS OF THE 6.2-keV GAMMA RAYS OF TANTALUM-181. Kaindl, G.; Salomon, D.; Wortmann, G. (California Univ., Berkeley. Lawrence Berkeley Lab.). Apr 1973. Contract W-7405-eng-48. 27p. (CONF-730117-3). Dep. NTIS $3.50.

From 8th Mossbauer Symposium; New York, New York, USA (28 Jan 1973).

Experimental technique and the more general aspects of ^{181}Ta isomer shifts are discussed first. The latter include high-resolution isomer shift results for source lattices ranging from V to Pt and absorber lattices of TaC and alkali titanates, the systematics of isomer shifts for ^{181}Ta impurities in transition metal hosts, and the change of the nuclear charge radius. The remainder of the paper is devoted to solid-state applications, such as the study of the dependence of the transition energy of the 6.2-keV gamma rays on temperature and hydrostatic pressure and explicit temperature dependence of the isomer shift. (9 figures, 6 tables) (RWR)

4167 POSITIVE PARITY STATES IN THE RARE-EARTH MASS REGION. Loevhoeiden, G.; Kanestroem, I. (Univ. of Oslo). Phys. Norv.; 6: No. 2, 33-60(1972).

The application of the Nilsson model with particle–rotation coupling to positive-parity states in deformed nuclei is reviewed. Energy levels, one-neutron transfer cross sections and electromagnetic transitions are evaluated. Furthermore, the systematics of the single-particle energies, rotational parameters and Coriolis coupling matrix elements are discussed. All the parameters used in the calculations are tabulated. The Nilsson model with Coriolis coupling offers a satisfactory interpretation of the relevant features for the odd-neutron nuclei in the mass region 153 < A < 185. (auth)

4168 EVIDENCE FOR SHAPE COEXISTENCE IN ^{151}Eu. Burke, D. G.; Loevhoeiden, G.; Waddington, J. C. (McMaster Univ., Hamilton, Ont.). Phys. Lett.; 43B: No. 6, 470-472(19 Mar 1973).

Although the ground states of ^{151}Eu and ^{153}Eu both have $I^\pi = 5/2^+$, the (p,t) transition connecting these states is extremely weak. A level at 261 keV with a large (p,t) cross section is assigned as the deformed $5/2^+$[413] state in the "spherical" nucleus ^{151}Eu. (auth)

4169 MEASUREMENT OF THE NUCLEAR MAGNETIC DIPOLE MOMENTS OF ^{177}Hf AND ^{179}Hf WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD. Buettgenbach, S.; Herschel, M.; Meisel, G.; Schroedl, E.; Witte, W. (Univ., Bonn). Phys. Lett.; 43B: No. 6, 479-480(19 Mar 1973).

The nuclear ground-state magnetic dipole moments of ^{177}Hf and ^{179}Hf were determined with the atomic beam magnetic resonance method. The results are: $\mu_I(^{177}\text{Hf}) = 0.7836(6)\mu_N$, $\mu_I(^{179}\text{Hf}) = -0.6329(13)\mu_N$(uncorrected for diamagnetic shielding). (auth)

4170 RESONANCE SCATTERING OF γ-QUANTA BY ^{177}Hf AND ^{159}Tb NUCLEI. Dautov, L. M.; Lysikov, Yu. A.; Makhanov, U. M.; Shubnyi, Yu. K. (Inst. of Nuclear Physics, Alma Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2544-2545(Dec 1972). (In Russian).

The lifetimes of the 249.6-keV level of ^{177}Hf ($(2.4 \pm 0.3) \times 10^{-10}$ s) and the 363.6-keV level of ^{159}Tb ($(1.92 \pm 0.24) \times 10^{-10}$ s) were determined by a neutron resonance scattering method. (3 figures) (tr-auth)

4171 CONVERSION ELECTRON SPECTRUM OF ^{183}Ta. Batist, L. Kh.; Berlovich, E. E.; Vaishnene, L. A.; Moroz, F. V.; Polyakov, A. G. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2546-2550(Dec 1972). (In Russian).

The conversion electron spectrum resulting from the decay of ^{183}Ta was investigated in the energy range 25 to 300 keV using a magnetic prism β spectrometer. The decay scheme and tables of intensities of internal conversions and cascade transitions are presented. (3 figures, 2 tables) (KSW)

4172 CALCULATION OF ENERGY SPECTRA FOR ^{154}Gd, ^{164}Er, ^{168}Yb, AND ^{180}W. Bravin, A. V.; Tereshin, Yu. V. (Saratov State Univ., USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2604-2606(Dec 1972). (In Russian).

The energy spectra of the ground-state, γ, and β bands for the nuclei ^{154}Gd, ^{164}Er, ^{168}Yb, and ^{180}W were calculated. (2 tables) (tr-auth)

4173 EXCITED STATES OF DEFORMED NONAXIAL ODD ATOMIC NUCLEI. Begzhanov, R. B.; Salakhitdinov, A. N.; Sharipov, Sh. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2597-2603(Dec 1972). (In Russian).

Energy spectra of excited states of nonaxial odd atomic nuclei were calculated. The spin of the ground state for the nuclei was $5/2$, and the possibility of a change in the shape of the nucleus during excitation and interaction between β and γ oscillations was included. A comparison of theoretical and experimental spectra of the isotopes Dy, Hf, Yb, Re, U, and Np was made. (3 figures) (tr-auth)

4174 DECAY OF ^{154}Tb. Vylov, Ts.; Gromova, I. I.; Kuznetsov, V. V.; Nedovesov, V. G.; Fominykh, V. I.; Khol'nov, Yu. V.; Shchukin, G. E. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 718-743(Apr 1972). (In Russian).

The x-ray and electron-$\gamma\gamma$ spectra of ^{154}Tb were investigated together with the levels of ^{154}Gd. The ^{154}Tb was prepared by the irradiation of a tantalum target with 180-MeV protons, followed by radiochemical and chromatographic isolation of the products, obtaining the Tb fraction by means of the mass separator. The half-life of ^{154}Tb was determined by recording the decay of the radiation intensity for 12 days; the values proposed are: 9.9 ± 0.1 hr and 23.1 ± 0.9 hr. The γ spectra were studied within 20-keV to 3.8-MeV range; the upper limit exceeds the decay energy of ^{154}Tb. The data were subjected to electronic data processing. The experimental data did not agree with those reported by B. Harmatz, T. Handley and J. Michelich in 1961; this may be due to the ^{154}Tb isomer with $I \leq 6$ and to the fact that the cross sections of formation of isomers of $I \leq 6$ and $I = 0$ in the (p, 2n) reactions at $E_p = 20$ MeV, and of deep spallation reaction at $E_p = 180$ MeV, differ by a factor of about 5; this confirms the existence of the new isomer of ^{154}Tb. The newly found 1419.71-keV transition has not been reported by the above authors, again probably because of the factor of 5. Spin values of 6^-, 7^- were ascribed to the 2137.4-keV level. The $T_{\frac{1}{2}} = 23.1 \pm 0.9$ hr value must be attributed to the isomer with the high spin. The half-life of the 0^- isomer was estimated at 22.0 ± 1.5 hr. (TTT)

4175 ALLOWED β DECAY OF ^{180}Lu. Grigor'ev, E. P. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 910-912(Apr 1972). (In Russian).

The properties of ^{180}Lu and the two-particle level of ^{180}Hf were analyzed in order to determine their quantum characteristics and to examine systematically the behavior of deformed nuclei. The calculation indicated that the 1607.8-keV level in ^{180}Hf must have a two-neutron character with $I^\pi = 4^+$: $m7/2^-[514\downarrow] + n1/2^-[510\downarrow]$ and in the case of the β^- decay of ^{180}Lu the transformation $n7/2^-[514\downarrow] \rightarrow p9/2^-[514\uparrow]$ takes place. The proton generated in the β decay is coupled with the odd proton in ^{180}Lu, and the 1607.8-keV level is a two-neutron particle–hole state. According to calculations based on the Woods–Saxon potential, this state lies at 1.8 MeV. The decay of the γ vibrational level of ^{180}Hf to the ground rotational band reveals that the ratio of the E2 transition probabilities agrees with the predictions of the generalized model. The ratio of the forbidden K transition probabilities from the 1607.8-keV level to the 4^+ and 2^+ ground level is close to 3.0, given by the Mikhailov formula. (TTT)

4176 γ–γ ANGULAR CORRELATIONS FOR ^{151}Gd. Vavryshchyk, Ya. (Marie Sklodowska-Curie Univ., Lublin); Zhuk, V.; Krupa, E.; Kuznetsov, V. V.; Morozov, V. A.; Fuya, Kh.; Khalikulov, A. B. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 757-766(Apr 1972). (In Russian).

Absence of accurate data on the spins of the excited states of ^{151}Gd could lead to wrong conclusions; therefore, the angular correlations were measured for the 287-108, 180-287, 192-287,

444-287, 479-108, 252-479, 252-587, 516-180, 731-108 keV $\gamma\gamma$ cascades and the 180-287-108 triple cascade without observing the intermediate transition. The ^{151}Tb source was prepared by the spallation reaction of tantalum exposed to 660-MeV protons, purifying it from the accumulated short-lived ^{147}Tb, ^{149}Tb, Gd and Eu isotopes by chromatographic separation. The results led to the conclusion that the spin of the 395.2-keV level (287-108 keV cascade) is $^3/_2$. In the 180-287 keV cascade, the multipolarity of the 180.1-keV transition is M1 + (4 ± 1.0)% E^2 for the spin sequence of $^1/_2$, $^3/_2$, and $^5/_2$. The results confirmed earlier data on the spins of the 395.2, 575.2, and 839.3 keV levels of the γ cascades of ^{151}Gd. The multipolarity data of low-energy levels also confirmed previous results. (TTT)

4177 ROTATIONAL BANDS IN ODD HAFNIUM NUCLIDES. Hultberg, S.; Rezenka, I.; Ryde, H. (Research Inst. for Physics, Stockholm). Nucl. Phys.; A205: No. 2, 321-347(1973).

Rotational bands up to high spin members in odd-neutron Hf nuclides are studied by in-beam spectroscopy using (α,xn) reactions on isotopically enriched Yb targets. The $^1/_2^-$[521], $^5/_2^-$[512], and the $^7/_2^+$ mixed positive-parity (mainly $^7/_2^+$[633]) bands were observed in ^{173}Hf and ^{175}Hf while the $^7/_2^-$[514], $^9/_2^+$ (mainly $^9/_2^+$[624]), and the 3QP (K = $^{23}/_2^+$) bands were studied in ^{177}Hf. The analysis of the band structure within the Nilsson model is extended to also include adjacent odd Hf nuclei making it possible to follow these bands through five isotopes of Hf. (auth)

4178 NOTE ON THE HIGHER ORDER EFFECTS IN THE NONUNIQUE FIRST FORBIDDEN BETA DECAYS OF ^{125}Sb, ^{186}Re, AND ^{152}Eu. Narasimha Raju, M. L.; Khayyoom, A.; Seshagiri Rao, V.; Sastry, D. L. (Univ. of Andhra, Waltair, India). J. Phys., A (London); 6: No. 4, 540-541(Apr 1973).

An attempt is made to determine the higher order effects in the nonunique first forbidden beta decays of ^{125}Sb, ^{186}Re and ^{152}Eu with matrix element parameters obtained using Simms' formalism (Phys. Rev.; 138: B 784-95(1965)). The experimental values of the CVC ratio are not in agreement with Fujita's estimate (Phys. Rev.; 126: 202-10(1962)) and support the view that the neglect of the nondiagonal matrix elements in the operator for the Coulomb potential is not valid. From the experimental values, limits are set on the magnitude of the correction factors and these provide a measurement of the higher order matrix element parameters. (auth)

4179 SHORT-LIVED ISOTOPES OF OSMIUM. Berlovich, E. E.; Blinnikov, Yu. S.; Vaishnis, P. P.; Vitman, V. D.; Elkin, Yu. V.; Ignatenko, E. I.; Panteleev, V. N.; Tarasov, V. K. (Inst. of Nuclear Physics, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2490-2498(Dec 1972). (In Russian).

An investigation was made of the short-lived ($T_{½} \leq 8$ min) Os isotopes. The discovery of ^{175}Os, $T_{½}$ = 1.4 min, and data on its γ spectra are described. Lighter Os isotopes with A = 172 to 174 were also studied. An isomeric state of ^{173}Os with $T_{½} \sim 3$ min and the new isotope, ^{174}Re, with $T_{½}$ = 2.2 min were detected. (6 figures, 6 tables) (tr-auth)

4180 LOW-LYING POSITIVE-PARITY STATES OF ^{151}Eu. Sen, S. (Saha Inst. of Nuclear Physics, Calcutta). J. Phys., A (London); 6: No. 4, L45-L47(Apr 1973).

The low-lying positive-parity states of ^{151}Eu are calculated by coupling single proton-hole motion to the quadrupole vibrations of the ^{152}Gd core. The energy levels and the B(E2) values are reproduced reasonably well, but the calculated and experimental spin assignments to some of the levels are in serious disagreement. (auth)

4181 HALF-LIFE MEASUREMENTS ON ^{172}Hf AND ^{194}Hg. Orth, C. J.; O'Brien, H. A. Jr.; Schillaci, M. E.; Dropesky, B. J. (Los Alamos Scientific Lab., NM). Inorg. Nucl. Chem. Lett.; 9: No. 6, 611-615(Jun 1973).

In the course of measuring cross sections of spallation products from 600-MeV proton bombardment of Pb and Bi, it was observed that the apparent yield of ^{194}Hg deviated widely from empirical cross-section estimates if the published half-life was used. The most recent compilation lists the accepted ^{194}Hg half-life as 1.3 y. New measurements are here described which show that the published values are substantially in error. Half-life measurements on ^{172}Hf were initiated when it was observed that in the bombardment of Ta with 600-MeV protons the ^{172}Hf cross section based upon the published half-life (5y) was ≈2.5 times larger than the systematics would indicate. After these measurements were in progress for several months Chu and Karol (Inorg. Nucl. Chem. Lett 1: 1205 (1971)) reported a ^{172}Hf half-life of 1.87 ± 0.03 y; the present data are in good agreement. (auth)

4182 LIFE-TIME OF ^{164}Yb ROTATION LEVELS MEASURED WITH THE DOPPLER EFFECT METHOD ON A RECOIL NUCLEI. Bochev, B.; Karamyan, S. A.; Kutsarova, T.; Ukhrin, Ya.; Nadzhakov, E.; Venkova, Ts.; Kalpakchieva, R. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 4, 633-639(Oct 1972). (In Russian).

With the help of a method, based on the effect of Doppler shift of γ-radiation of excited recoil nuclei, there was measured life-time of rotation band of the ground state for ^{164}Yb isotope, produced in ^{128}Te(^{40}Ar,4n) reaction. The obtained values B(E2; j → j − 2) are compared with theoretical ones for a rigid rotator. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 4049, 4075, 4122, 4123, 4128, 4135, 4138, 4149, 4181, 4204, 4270, and 4288.

4183 (JINR−P1-6961) DOUBLE CHARGE EXCHANGE OF π^+ MESONS ON ^{209}Bi NUCLEI. Batusov, Yu. A.; Ganzoring, Zh.; Dudova, I. V.; Osipenko, B. P.; Sidorov, V. M.; Khalkin, V. A.; Chultem, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The reactions of the double charge exchange of π^+-mesons on bismuth nuclei: $\pi^+ + {}^{209}\text{Bi} \rightarrow {}^{209-x}\text{At} + \pi^- + \text{xn}$ were studied. Identification of astatine isotopes or the daughter polonium-product was performed by the α-particle registration and their energy measurements. The $\pi^+ + {}^{209}\text{Bi} \rightarrow \pi^- + {}^{207}\text{At} + 2\text{n}$ reaction cross section was found to be $(12 \pm 3) \cdot 10^{-29}$ cm^2. Estimate of the cross section upper limit for the elastic double charge exchange of π^+-mesons on Bi nuclei is $\leq 10^{-29}$ cm^2. Possible mechanism of ^{211}At production in the reaction $\pi^+ + {}^{209}\text{Bi} \rightarrow {}^4\text{He} + \ldots {}^4\text{He} + {}^{209}\text{Bi} \rightarrow {}^{211}\text{At} + 2\text{n}$ is considered. (auth)

4184 ISOMERIC TRANSITION IN ^{198}Au. Pakkanen, A.; Puumalainen, P.; Helppi, H.; Komppa, T. (Univ. of Jyvaeskylae, Finland). Nucl. Phys.; A206: No. 1, 164-168(1973).

An isomeric 115.2-keV transition from the high-spin 2.36-d state in ^{198}Au was observed. The multipolarity of this transition is probably M4, and it suggests a configuration of $(\pi h_{11/2})(\nu i_{13/2})12^-$ for the isomeric state at 811.9 ± 1.5 keV. The multipolarities E2 (+<2% M1) and M1(+<20% E2) were determined for the 180.30- and 204.13-keV γ rays, respectively. (2 figures, 2 tables) (auth)

4185 INELASTIC SCATTERING OF DEUTERONS, PROTONS, AND TRITONS ON ^{210}Po. Ellegaard, C. (Carnegie–Mellon Univ., Pittsburgh); Barnes, P. D.; Eisenstein, R.; Romberg, E.; Bhatia, T. S.; Canada, T. R. Nucl. Phys.; A206: No. 1, 83-96(1973).

Collective states in ^{210}Po was studied with inelastic scattering of deuterons, protons, and tritons. A 3^- state was found at 2.39 MeV with an intensity corresponding to (90 ± 10)% of the first ^{208}Pb 3^- state. Two 5^- states at 2.91 and 3.03 MeV divide almost equally the intensity observed for the first 5^- state in ^{208}Pb. The B(E2) value for the first 2^+ state was found to be just slightly enhanced over the single-particle value for an $(h^2_{9/2})_{0\rightarrow 2}$ transition, and corresponds to 20% of the B(E2) for the first 2^+ state of ^{206}Pb. The results are discussed in terms of the particle–vibration coupling model, and quantitative agreement is obtained for the 3^- state. (7 figures, 2 tables) (auth)

4186 ELECTRIC MULTIPOLE MOMENTS AND TRANSITION PROBABILITIES OF SINGLE-PARTICLE STATES IN THE LEAD REGION. Ring, P. (Technische Univ., Garching, Ger.); Bauer, R.; Speth, J. Nucl. Phys.; A206: No. 1, 97-113(1973).

Electric quadrupole moments as well as E2 and E3 transition probabilities were calculated within the theory of finite Fermi systems for single-particle states in the lead region. Their dependence on the force parameters of the residual interaction was studied, and a set of parameters which yields good agreement with a large group of experimental data in this region is given. (7 figures, 9 tables) (auth)

4187 g-FACTOR DIFFERENCE FOR THE 6^+_1 AND 8^+_1 STATES IN ^{210}Po. Baba, C. V. K. (Munich Univ., Garching, Ger.); Fossan, D. B.; Faestermann, T.; Feilitzsch, F.; Kienle, P.; Signorini, C. Phys. Lett.; 43B: No. 6, 483-486(19 Mar 1973).

The difference in g-factors for the 6^+_1 and $8^+_1(\pi h^2)$states in ^{210}Po was measured as $(g_6 - g_8)/g_8 = 2.0 \pm 0.7\%$. This result represents a small violation of additivity. A value of $g_8 = 0.909 \pm 0.011$, independent of g_6, was also obtained. (auth)

4188 PHOTONEUTRON CROSS SECTIONS AND SPECTRA FROM MONOENERGETIC PHOTONS ON Y, Pr, Pb, AND Bi IN THE GIANT RESONANCE. Young, L. M. Urbana, IL; Univ. of Illinois (1972). 94p. University Microfilms Order No. 73-10,095.

Thesis (Ph. D.).

The time-of-flight photoneutrons from Y, Pr, Pb, and Bi were observed for monoenergetic gamma rays in the giant resonance. Twelve one-inch-wide electron counters were mounted on the beta-ray spectrometer so that data could be taken simultaneously at twelve photon energies. The bremsstrahlung monochromator makes it possible to obtain both the energy and production time of the gamma ray. The energy of the gamma rays was defined to within ¾%. This experiment measured the time-of-flight spectra of the photoneutrons emitted from the target with a resolution which varied from 16% at 1 MeV to 26% at 8 MeV. The cross sections for Y, Pr, Pb, and Bi had better gamma-ray energy resolution than any previous cross section data. The results show that the photoneutron cross sections for these elements are well described by a Lorentzian line shape; deviations occur but are minor. The spectra were analyzed by assuming the photoneutrons could be classified into two groups, statistical neutrons produced by neutron evaporation and nonstatistical neutrons. These nonstatistical neutrons exhibited a pattern which indicated that the fraction of nonstatistical neutrons which left the residual nucleus in the same group of energy levels was independent of the neutron energy. (RWR)

4189 CONFIGURATION MIXING AND EFFECTIVE CHARGE IN ^{211}At. Isakov, V. I.; Kozhamkulov, T. A.; Sliv, L. A. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 798-804(Apr 1972). (In Russian).

The configuration of the ^{211}At nucleus may be calculated from the residual forces determined from the properties of the ^{210}Po nucleus. These residual forces were calculated to be $v_0 = -30$ MeV, $v_1 = -20$ MeV and $v_T = 0$. Only the lower states of ^{211}At were considered; therefore, only configurations the zero energy of which does not exceed 3 MeV were used. The effect of the collective states of the core on the energy of the three-particle level causes some additional attraction between the particles but does not change the order of succession of the levels. The parameters of the residual interaction were derived from the properties of the ^{210}Po nucleus and the parameter determining the interaction of one-particle and collective excitation from the properties of the ^{208}Po nucleus. The calculated values agreed with experimental findings. (TTT)

4190 RESONANCE SCATTERING OF γ-QUANTA BY ^{194}Pt AND ^{195}Pt NUCLEI. Shubnyi, Yu. K.; Lysikov, Yu. A. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2531-2532(Dec 1972). (In Russian)

Lifetimes of the 328- and 98.7-keV states of ^{194}Pt and ^{195}Pt were measured by nuclear resonance scattering; the values $(5.1 \pm 0.7) \times 10^{-11}$ and $(1.2 \pm 0.2) \times 10^{-9}$ sec, respectively, were obtained. (2 figures) (tr-auth)

4191 DETERMINATION OF THE RELATIVE CONVERSION COEFFICIENTS FOR THE 77-keV TRANSITION OF ^{197}Au AND THE 134- AND 165-keV TRANSITIONS OF ^{197}Hg. Padalko, V. Yu.; Zarubin, P. P.; Khrisanfov, Yu. V. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2551-2554(Dec 1972). (In Russian).

The ratios of conversion probabilities were determined for the 77-keV transition in ^{197}Au and two ^{197}Hg transitions: 134 and 165 keV. The multipole orders of these transitions were obtained. (1 figure, 2 tables) (tr-auth)

4192 EFFECTIVE CHARGE OF E1 TRANSITIONS IN THE LEAD REGION. Hamamoto, I. (Technical Univ., Munich). Nucl. Phys.; A205: No. 2, 225-238(1973).

An attempt was made to obtain the E1 effective charges for both neutrons and protons from analyzing the decay scheme of the octupole vibrational states in the nuclei around ^{208}Pb. The resulting values of e_{eff}(E1) in the lead region for neutrons are appreciably smaller than those for protons. (auth)

4193 DECAY AMPLITUDES OF THE ^{208}Pb(0$^+$) ANALOGUE RESONANCE. Booth, E. C.; Madsen, B. S. (Univ. of Copenhagen). Nucl. Phys.; A206: No. 2, 293-304(1973).

Measurements were made of elastic and inelastic proton scattering by ^{207}Pb targets in the energy range from 11.1 to 14.4 MeV. The scattering to the $\frac{1}{2}^-$ ground state and to the $\frac{3}{2}^-$ and $\frac{5}{2}^-$ excited levels was analyzed in terms of a 0$^+$ analog resonance interfering with the nonresonant background and with the contribution from the 3$^-$ resonance. The resonance parameters were determined together with the magnitude and relative sign of three background components. (3 figures, 6 tables) (auth)

4194 STUDY OF NUCLEAR FISSION INDUCED BY HIGH-ENERGY PROTONS. Brandt, R. (Univ., Marburg, Ger.); Carbonara, F.; Cieslak, E.; Piekarz, J.; Zakrzewski, J.; Piekarz, H. Rev. Phys. Appl.; 7: No. 4, 243-251(Dec 1972).

Binary fission cross-sections of uranium, bismuth, lead, gold and some lighter elements were determined for proton energies between 0.59 and 23 GeV using the mica sandwich technique. (FR)

4195 GYROMAGNETIC RATIO OF THE 208 keV $\frac{3}{2}^-$ STATE OF ^{199}Hg. Kalish, R. (Technion-Israel Inst. of Tech., Haifa); Herskind, B.; Borchers, R. R.; Heestand, G. M. Nucl. Phys.; A206: No. 3, 558-562(1973).

The ion-implantation perturbed-angular-correlation technique was used to measure the g factor of the $\frac{3}{2}^-$ state at 208 keV of ^{199}Hg recoiling into iron. A value $g(\frac{3}{2}^-) = 0.35 \pm 0.11$ was deduced from the data. This result is in agreement with predictions of an extended core excitation model. (auth)

4196 ELASTIC SCATTERING OF γ-RAYS FROM LEAD FOR ENERGIES FROM 0.145 TO 1.33 MeV. Schumacher, M.; Smend, F.; Borchert, I. (Univ., Goettingen, Ger.). Nucl. Phys.; A206: No. 3, 531-544(1973).

Differential cross sections for elastic scattering of 889- and 1120-keV γ rays by lead were measured at angles ranging from 30° to 150°. These results and previously measured differential cross sections at 145, 279, 412, 662, and 1332 keV are compared with theoretical predictions with Rayleigh scattering, nuclear Thomson scattering, and Delbrueck scattering taken into account. The Rayleigh amplitudes of the K shell were obtained from the theory of Brown et al. [Proc. Roy. Soc., A242: 89(1957)]; the amplitudes of the other shells, from form factors calculated from relativistic HFS wave functions. Discrepancies were found at 145, 889, 1120, and 1332 keV, while the experimental data at 279, 412, and 662 keV are in good agreement with the theory. A discussion of possible explanations and consequences is presented. (8 figures, 3 tables) (auth)

4197 E0/E2 AND E2/M1 MULTIPOLE MIXING AMPLITUDES OF γ TRANSITIONS IN ^{192}Pt. Holm, J. L. (Purdue Univ., Lafayette, IN). Nucl. Phys.; A206: No. 3, 614-622(1973).

Angular correlation measurements of conversion electrons and γ rays in ^{192}Pt following the decay of ^{192}Ir(74 d) were made. In particular, the 296-keV $e^- - 316$-keV γ correlation was measured in order that the electric monopole admixture in the 296-keV transition could be determined. The results of the angular correlation coefficients measured here and the ratio of K-shell to L_{III}-shell conversion electrons measured by others are $-0.09 < q < +0.26$ as $+62 < \lambda < +92$ or $-0.29 < q < -0.06$ as $-5 < \lambda < +45$. A possible explanation of the disagreement between two earlier measurements is suggested. The angular correlation coefficients for the measured $e^- - \gamma$ and $\gamma - \gamma$ cascades and the derived multipole mixing ratios are tabulated and compared with other recent measurements and with the predictions of the Kumar–Baranger nuclear model. (2 figures, 3 tables) (auth)

4198 CORE POLARIZATION EFFECTS IN THE $\pi h_{9/2}$ SHELL AND g-FACTORS OF THE 8$^+$ STATES IN ^{204}Po AND ^{206}Po. Braeuer, N. (Freie Univ., Berlin); Goldmann, A.; Hadijuana, J.; Von Hartrott, M.; Nishiyama, K.; Quitmann, D.; Riegel, D.; Zeitz, W.; Schweickert, H. Nucl. Phys.; A206: No. 3, 452-458(1973).

The g values of $[(\pi h_{9/2})^2, 8^+]$ isomeric levels in ^{204}Po and ^{206}Po were measured with the stroboscopic method. The results obtained are $g(^{204}\text{Po}) = 0.923 \pm 0.013$ and $g(^{206}\text{Po}) = 0.919 \pm 0.013$. These and other known g factors of $(\pi h_{9/2})^n$ states in the ^{208}Po region are compared with theoretical predictions in order to analyze the dependence of the $h_{9/2}$ proton g value on the core constitution. The variation of the g values is systematically smaller than expected from first-order configuration mixing theory, if pure shell-model wave functions are assumed. (3 figures) (auth)

4199 ABSOLUTE PROBABILITIES FOR α-DECAY OF EVEN–EVEN NUCLEI $174 \leq A \leq 232$ AND SUPERFLUIDITY. Kadmenskii, S. G.; Kalechits, V. E.; Martynov, A. A. (Voronezh State Univ., USSR). Yadern. Fiz.; 16: No. 4, 717-724(Oct 1972). (In Russian).

In the framework of the non-R-matrix approach the calculations on absolute probabilities of α-decay for 58 Pt, Hg, Po, Rn, Ra, Th isotopes are carried out. It is shown, that account for superfluid correlations leads to intensification of absolute probabilities of α-decay for the investigated nucleus range from 130 up to 3300 times and allows one to obtain qualitative agreement in behavior of relative experimental and theoretical α-widths. A conclusion is made, that residual interactions in nuclei, close to magic ones in the number of neutrons and protons, are quite large and are considerably underestimated in the well known calculations in the framework of the shell model with configuration mixing. It has been

found, that account for α-particle structure, decreases absolute probabilities of decay and makes them 10–100 times less than experimental ones. Conclusions are made on necessity of more detailed study of the structure effects to get an agreement between the theoretical and experimental absolute widths of α-decay. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 2210, 2662, 4149, 4173, 4194, 4199, and 4291.

4200 (AECL–4453) YIELDS IN THERMAL NEUTRON FISSION. Some Results and Recommendations Based on a Recent Evaluation. Walker, W. H. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Mar 1973. 23p. (CONF-730302–11). Dep. NTIS (U. S. Sales Only) $3.25. AECL $0.50.

From symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

A careful analysis of cumulative yields in the thermal-neutron fission of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu has recently been completed (AECL-3037, Part II). The methods used and some of the problems encountered are discussed. Errors are assigned to all yields, and the effects of the corresponding uncertainties in neutron absorption and reactivity are estimated. A program of measurements which could reduce the major uncertainties requires mass spectrometric measurements of radioactive and stable isobars for a given fissile species plus γ-ray measurements for all four fissile species of relative yields for a large number of radioactive nuclides that are isobaric with nuclides for which the yields have been measured mass spectrometrically. These measurements are discussed and recommendations are made for presentation of data in a way that will minimize uncertainties in future evaluations. (2 figures, 5 tables) (auth)

4201 (FEI-325) CLASSIFICATION OF TECHNIQUES FOR MEASURING THE RATIO OF NEUTRON CAPTURE CROSS SECTION TO FISSION CROSS SECTION. Van'kov, A. A.; Grigor'ev, Yu. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko Energeticheskii Institut). 1972. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The classification of well-known differential methods for measuring the value of α, the ratio of neutron radiative capture cross section to fission cross section, is discussed. In view of the advancement of the criteria of comparison mentioned, there exists the possibility of significantly diminishing the amount of error in α associated with the normalization procedure. An annotated bibliography appears in an appendix. (1 figure) (tr-auth)

4202 (IFA-NR-41-1972) MULTILEVEL CALCULATION OF ^{235}U NEUTRON FISSION CROSS-SECTION. Mihailescu, I. M.; Petrascu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

A multilevel calculation of the ^{235}U neutron fission cross section is presented. The values for neutron energy less than 2 eV were computed with a program written in FORTRAN IV. The curves obtained using the multilevel and single-level fission cross section formula are compared with experimental data. The failure of the single-level formula is obvious. The values computed for neutron energies less than 0.6 eV are in good agreement with the experimental points found in the measurements to determine absolutely the ^{235}U fission cross section for 2200 m/s neutrons. The influence of the bound resonance levels in computing the fission cross section values for low-energy neutrons is studied. (3 figures, 2 tables) (auth)

4203 SPONTANEOUSLY FISSIONING ^{236m}U ISOMER EXCITED WHEN CAPTURING THERMAL NEUTRONS. Popeko, L. A.; Petrov, G. A.; Kochubei, E. F.; Zvezdkina, T. K. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 2, 234-241(Feb 1973). (In Russian).

The probability of production of the spontaneously fissioning ^{236m}U isomer, when capturing thermal neutrons by ^{235}U and further cascade γ-transitions was experimentally studied. Delayed coincidences of fission fragments with conversion electrons, characteristic roentgen radiation of K and L series of uranium and soft γ-radiation with energy 20 to 200 keV, were measured. Having analyzed the measurement results and assuming that the value of half-life period for spontaneously fissioning isomer lies within 50 to 120 nsec, one has obtained the yield of roentgen K and radiations not to be higher than $2 \cdot 10^{-5}$ quantum/fission. One can predict approximately with the same accuracy, an absence of any γ-line with energies less than ~200 keV which are prior to isomer fission. The obtained data are analyzed in the framework of the hypothesis on the double peak barrier. (auth)

4204 NEUTRON SPECTRA EMITTED BY ^{239}Pu, ^{238}U, ^{235}U, Pb, Nb, Ni, Al, AND C IRRADIATED BY 14 MeV NEUTRONS. Kammerdiener, J. L. Davis, CA; Univ. of California (1972). 221p. University Microfilms Order No. 73-9127.

Thesis (Ph. D.).

The ICT time-of-flight facility at Lawrence Livermore Laboratory was used to measure the elastic and inelastic differential scattering cross sections of nominally 14-MeV neutrons by targets of ^{239}Pu, ^{238}U, ^{235}U, Pb,,Nb, Ni, Fe, Al, and C. Ring geometry and time-of-flight were used to measure scattered neutrons over four decades of energy between 10 keV and 14 MeV at an energy resolution of $E^{3/2}/200$ (MeV). Measurements were made in 5 degree increments between 20 and 160 degrees (lab) with an angular resolution of 2 degrees. An Ne-213 scintillation detector was used to detect scattered neutrons with energy greater than one MeV. Pulse shape discrimination circuitry allowed simultaneous recording of both neutron and gamma (pulse height spectrum) data with low background. A ^{6}Li-glass detector was used for measurements below 1 MeV. Statistical uncertainities are less than 10%. Scattering from the 1 cm × 2 cm × 22 cm ring targets was corrected for multiple scattering, flux attenuation, isotopic abundance by Monte Carlo calculations. The 2^+ levels of Fe and Ni were clearly resolved, but 3^- levels expected at similar excitation energies in ^{239}Pu, ^{238}U, ^{235}U were not seen. (Diss. Abstr. Int., B)

4205 SEARCH FOR SUPERHEAVY ELEMENTS IN TERRESTRIAL MINERALS AND COSMIC RAY INDUCED FISSION OF HEAVY ELEMENTS. Geisler, F. H. St. Louis; Washington Univ. (1972). 175p. University Microfilms Order No. 73-5039.

Thesis (Ph. D.).

A new low-level nuclear fission counting technique was developed. The counting method employed thin Kimfol plastic detectors to record the fission fragments. The etched fission tracks were located by a pulse sparking technique. This technique has an improved signal to noise ratio over previous techniques of three million times with respect to spurious background tracks in the plastic. The low-level counting in the superheavy element search was performed deep underground. Forty samples, comprising a wide class of minerals, were examined. No spontaneous fission events above the background level were observed. An upper limit of 6×10^{-12} g/g was set in a typical sample for the concentration of any such nuclei with a half-life of 10^9 years. Three uranium determination methods were developed. The following upper limits on the decay rate of spontaneous fission can be set from the upper limits on the activity of the heavy element minerals: $(2.6 \pm 2.6) \times 10^{-23}$ yr^{-1} for lead, $(2.6 \pm 1.6) \times 10^{-23}$ yr^{-1} for mercury, and $(4.2 \pm 4.2) \times 10^{-21}$yr^{-1} for thorium. Additional low-level fission counting experiments were performed at sea level and at a small depth underground. The theoretically predicted cosmic-ray-induced fission rate of lead agrees with the measured rate; however, there is a large discrepancy in the two thorium values, which implies a smaller cosmic-ray neutron flux in the 1 MeV to 50 MeV region than has been calculated theoretically. Spontaneous fission activity observed by CERN scientists in a heavy element target bombarded with high-energy protons has been previously interpreted as evidence for superheavy element production; however, the upper limit on the spontaneous fission activity of a similarly prepared sample in this experiment suggests that contamination was the source of the activity observed in the CERN work. Previous Russian work detected fossil fission events in old lead glass; however, this experiment casts doubt on the assignment of the fission decays to a superheavy element. (RWR)

4206 PHOTOFISSION CROSS SECTIONS OF ^{238}U AND ^{235}U FROM 5.0 MeV TO 8.0 MeV. Anderl, R. A. Ames, IA; Iowa State Univ. (1972). 122p. University Microfilms Order No. 73-9422.

Thesis (Ph.D.).

Cross sections extracted from measured yield curves are reported for photofission of ^{238}U and ^{235}U. Surface barrier detectors were used to measure the fission yields from metal foil targets of ^{238}U (enriched to 99.97%) and ^{235}U (enriched to 97.68%) for maximum photon energies stepped from 5.0 MeV to 8.0 MeV in 0.1 MeV increments. The photons were obtained by Compton scattering gamma rays produced by neutron capture in a nickel plate near the core of the 5 MW Ames Laboratory Research Reactor. An unfolding procedure was used to extract the smoothed cross sections from the measured yield curves. In the $^{238}U(\gamma,f)$ cross section, prominent structure is observed at 6.2 MeV and 7.6 MeV with hints of structure at 5.5 MeV and 7.0 MeV. The

$^{235}U(\gamma,f)$ cross section shows pronounced structure at 5.9 MeV, 6.6 MeV, and 7.5 MeV with a hint of structure at 5.4 MeV. These cross sections are compared with previous photofission measurements, and are discussed in the framework of Bohr's "fission channel" theory. (Diss. Abstr. Int., B)

4207 CORRELATION BETWEEN FRAGMENT MASS-DISTRIBUTION FINE STRUCTURE, CHARGE DISTRIBUTION, AND NUCLEAR STRUCTURE FOR THERMAL-NEUTRON-INDUCED FISSION OF ^{233}U AND ^{235}U. Reisdorf, W. N.; Unik, J. P.; Glendenin, L. E. (Argonne National Lab., IL). Nucl. Phys.; A205: No. 2, 348-362(1973).

Masses corresponding to observed fine-structure peaks in the fragment mass distributions for thermal-neutron-induced fission of ^{233}U and ^{235}U are shown to correspond to average measured masses for even–even nuclear charge splits. Evidence is presented that the yield enhancement for even-Z fragments is not restricted just to fission events with higher-than-average total kinetic energy. The anomalously high yield of fragments with mass 134 in $^{235}U(n,f)$ as opposed to $^{233}U(n,f)$ is tentatively correlated with rapidly changing nuclear structure properties as a function of the mass of the complementary light (Z = 40) fragments. (auth)

4208 GAMMA RAYS OF PRIMARY FISSION PRODUCTS FROM $^{235}U(n,f)$ AND $^{239}Pu(n,f)$. Schindler, W. J.; Fleck, C. M. (Oesterreichische Hochschule, Vienna). Nucl. Phys.; A206: No. 2, 374-384(1973).

Gamma rays of primary fission products in thermal-neutron-induced fission of ^{235}U and ^{239}Pu were investigated. Isotopic assignments of several lines were made by comparing fission yield ratios and relative γ-ray intensities of the two fissioning nuclei. Differences between ^{235}U and ^{252}Cf fission product γ-ray lines are discussed. (5 figures, 2 tables) (auth)

4209 PHOTOFISSION CROSS SECTIONS OF ^{232}Th AND ^{236}U FROM THRESHOLD TO 8 MeV. Yester, M. V.; Anderl, R. A.; Morrison, R. C. (Ames Lab., Iowa). Nucl. Phys.; A206: No. 3, 593-613(1973).

Measurements of the photofission cross sections of ^{232}Th and ^{236}U for an energy range of 5.0 to 8.0 MeV are reported. The Compton scattering facility at the Ames Laboratory Research Reactor was used for these measurements. Resonance structure at γ-ray energies of 6.3 and 7.6 MeV was observed in ^{232}Th, and at 5.3, 6.0, 6.5, and 7.5 MeV in ^{236}U. The results are compared with other photofission experiments and particle-induced fission studies. Suggestions for the interpretation of the resonances are given on the basis of Bohr's fission-channel theory and the existence of a double-humped fission barrier. (13 figures, 1 table) (auth)

4210 THERMAL-NEUTRON CAPTURE CROSS SECTIONS AND CAPTURE RESONANCE INTEGRALS OF AMERICIUM-241. Harbour, R. M.; MacMurdo, K. W.; McCrosson, F. J. (E. I. du Pont de Nemours and Co., Aiken, SC). Nucl. Sci. Eng.; 50: No. 4, 364-369(Apr 1973).

The partial 2200-m/sec equivalent neutron capture cross sections (σ_{2200}) and neutron capture resonance integrals (I_c) of 432.7-yr ^{241}Am to produce 152-yr ^{242m}Am and 16.01-h ^{242g}Am were measured relative to ^{59}Co standards. The number of ^{242m}Am atoms produced per ^{241}Am target atom was determined by high precision mass spectrometry after chemical purification of americium. The number of ^{242g}Am atoms produced per ^{241}Am target atom was determined by measuring the alpha activity of its 164.4-day ^{242}Cm daughter. The measured values for ^{241}Am are as follows: σ_{2200} (to ^{242m}Am) = 83.8 ± 2.6 b, I_c (to ^{242m}Am) = 208 ± 18 b (0.369-eV cutoff), σ_{2200} (to ^{242g}Am) = 748 ± 20 b, and I_c (to ^{242g}Am) = 1330 ± 117 b (0.369-eV cutoff). Measured values are compared with those calculated from the ENDF/B-III neutron cross-section library. (auth)

4211 ADJUSTMENT OF MULTIGROUP NEUTRON CROSS SECTIONS BY A CORRELATION METHOD. Salvatores, M. (CSN, Casaccia, Italy). Nucl. Sci. Eng.; 50: No. 4, 345-353(Apr 1973).

The benchmark experiments, performed in a plutonium-fueled critical assembly (ZPR-6 Assembly 7) in support of the fast reactor demonstration plant program, were used, in conjunction with a statistical method of correlation, as a source of suggestions for possible modifications to multigroup neutron cross-section sets based on ENDF/B files. Version 1 of these files was a starting point in the correlation procedure. The general trends of the results (lower ^{238}U capture cross section and ^{235}U fission cross section, higher ^{239}Pu capture to fission ratio, with respect to ENDF/B Version 1 data) are discussed, and the suggested multigroup cross-section adjustments are compared with recent evaluations. Calculations of k_{eff}, and of the ratios of ^{238}U and ^{235}U fission rate and of ^{238}U capture rate to ^{239}Pu fission rate, using the proposed adjusted set, give results in good agreement with the experiments. (auth)

4212 EQUIPMENT AND TECHNIQUES FOR THE STUDY OF THE DECAY OF ^{235m}U. Neve de Mevergnies, M. (CEN, Mol, Belgium). Nucl. Instrum. Methods; 109: No. 1, 145-155(1973).

Due to the extremely low energy of the ^{235m}U isomeric transition its decay rate can be perturbed by changes in the outermost electron subshells. Techniques for the source preparation and detecting systems for analyzing the energy distribution of the conversion electrons and for measuring accurately the decay rate are described. (auth)

4213 SUPER-HEAVY ELEMENTS. Kapoor, S. S. (Bhabha Atomic Research Centre, Trombay, India). Sci. Cult. (Calcutta); 38: No. 5, 224-235(May 1972).

The nuclear properties, decay, attempted production, and chemical and physical properties of the superheavy elements are reviewed. The search for these elements in nature is included. 36 references. (LTW)

4214 REVIEWS OF THE MEASUREMENTS OF α FOR ^{239}Pu IN THE ENERGY RANGE 100 eV TO 1 MeV. Sowerby, M. G.; (Atomic Energy Research Establishment, Harwell, Eng.); Konshin, V. A. At. Energy Rev.; 10: No. 4, 453-527(Dec 1972).

A review has been made of the differential measurements of the ratio of the capture to fission cross sections (alpha) for ^{239}Pu in the energy range 100 eV to 1 MeV. The methods of measuring alpha are discussed and it is concluded that no detector system used to date is perfect. The history of measurements made prior to 1967 is presented and from this the dangers of relying upon calculations for accurate data can be seen. The alpha measurements in the energy range 100 eV to 30 keV, where the data are most discrepant, are considered in detail and possible sources of error in the measurements are identified. An evaluation covering the energy region 100 eV to 1 MeV is performed using the data available in March 1971 and the recommended values are considered to be accurate to approximately ±10% below 30 keV, increasing to ±20% at 100 keV and ±30% at 1 MeV. These recommended values are then compared with the new differential measurements published between March and December 1971 and with integral data and it is concluded that the agreement is satisfactory. A number of recommendations regarding further measurements are summarized in the conclusions. (auth)

4215 STATUS OF THE ENERGY-DEPENDENT $\bar{\nu}$-VALUES FOR THE HEAVY ISOTOPES (Z > 90) FROM THERMAL TO 15 MeV AND OF $\bar{\nu}$-VALUES FOR SPONTANEOUS FISSION. Manero, F.; Konshin, V. A. (International Atomic Energy Agency, Vienna). At. Energy Rev.; 10: No. 4, 637-756(Dec 1972).

A thorough compilation of all measurements published up to August 1972 on the energy-dependent $\bar{\nu}$-values for prompt and delayed fission neutrons, from thermal to 15 MeV, for the heavy isotopes with Z ≥ 90, and for the $\bar{\nu}$-values for spontaneous fission has been performed. The compilation includes not only the numerical data but also the essential physical information related to the measurements, i.e., method of measurement, type of detector and standard used, analysis and corrections carried out and errors considered. The experimental data have been renormalized to recommended standards. A weighted least squares orthogonal polynomial fitting analysis was applied to the renormalized data and "best fits" deduced for the energy dependence of the $\bar{\nu}_p$ values of each isotope. Tables of recommended values of $\bar{\nu}_p$ and $\bar{\nu}_t$ as a function of the incident neutron energy are included. (auth)

4216 SIMULTANEOUS EVALUATION OF THE ^{239}Pu FISSION CROSS-SECTION AND THE $^{239}Pu/^{235}U$ FISSION CROSS-SECTION RATIO IN THE FAST NEUTRON ENERGY REGION. Byer, T. A. (International Atomic Energy Agency, Vienna). At. Energy Rev.; 10: No. 4, 529-636(Dec 1972).

The most important neutron data uncertainties that affect the design and operation of fast breeder power reactors are those associated with the main fissile and fertile isotopes, ^{239}Pu and ^{238}U respectively. In view of this, the IAEA Nuclear Data Section has undertaken and/or sponsored extensive reviews of the present status of $\alpha(\sigma_c/\sigma_f)$ of ^{239}Pu, $\bar{\nu}$ for the fissile and fertile isotopes, the fast capture-cross-section of ^{238}U and the fast fission cross-section of ^{239}Pu. In this review the final results of a simultaneous evaluation of the ^{239}Pu fast fission cross-section and the fast fission cross-section ratio of $^{239}Pu/^{235}U$ are presented. The approach used in the present evaluation differs from that adopted in most previous evaluations in that the simultaneous technique was employed in evaluating σ_f ^{239}Pu and the ratio σ_f $^{239}Pu/\sigma_f$ ^{235}U. In this way it was possible to deduce σ_f ^{235}U over an entire energy region. This deduced σ_f ^{235}U result was then compared with the existing ^{235}U fast fission cross-section experimental data and by a process

of repeated iteration the starting values of the two primary cross-section types, σ_f ^{239}Pu and σ_f ^{239}Pu/σ_f ^{235}U, were adjusted, within their uncertainties, so that one may simultaneously achieve consistency for σ_f ^{239}Pu, σ_f ^{239}Pu/σ_f ^{235}U and σ_f ^{235}U. This is essentially a form of "bootstrap" technique, which has been applied to the three cross-section types. One of the important advantages of this approach, quite apart from that of more fully exploiting the algebraic relationship between the cross-sections, is that it enables one to arrive at rather important deductions concerning discrepancies between different experimental results for the same physical quantity. To arrive at the "best curve" through the experimental data, a weighted least-squares orthogonal polynomial fitting was used. In addition to the recommended values of σ_f ^{239}Pu and σ_f ^{239}Pu/σ_f ^{235}U, an attempt has been made to estimate the total coefficient of variation of these recommended values over certain energy regions. (auth)

4217 ANGULAR DISTRIBUTION OF FRAGMENTS IN ^{249}Cf FISSION BY NEUTRONS. Vorotnikov, P. E.; Gokhberg, B. M.; Dubrovina, S. M.; Otroshchenko, G. A.; Shigin, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 16: No. 4, 664-666(Oct 1972). (In Russian).

The results on angular distributions of fission fragments in ^{249}Cf(n,f) reaction obtained at neutron energies E_n = 0.16 to 1.7 MeV and 5 MeV are presented. The fragments were detected with glass. Energy resolution was ±50 keV. Angular distribution for each value of neutron energy may be presented as $W_\theta = (1 + a \cos^2 \theta)W_{90°}$. (auth)

4218 SEARCH FOR SPONTANEOUSLY FISSIONING ISOMER ^{240m}Pu IN THE REACTION OF THERMAL NEUTRONS CAPTURE. Val'skii, G. V.; Mrachkovskii, O. M.; Petrov, G. A.; Pleva, Yu. S. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 16: No. 4, 667-669(Oct 1972). (In Russian).

The production probability of spontaneously fissioning isomer ^{240m}Pu with a half-life time ~4.4 nsec in the reaction of capturing of thermal neutrons was measured. The ratio of the isomer production cross section and the cross section of spontaneous fission σ_i/σ_f was found to be equal to $(0.67 \pm 0.42) \cdot 10^{-4}$ or $(0.97 \pm 0.61) \cdot 10^{-4}$ depending on whether two or one γ-quanta with the energy $E_\gamma > 800$ keV forego the populating of isomeric state. (auth)

4219 INVESTIGATION OF ^{235}U FISSION BY THERMAL NEUTRONS. Zakharova, V. P.; Ryazanov, D. K.; Basova, B. G.; Rabinovich, A. D.; Korostylev, V. A. Yadern. Fiz.; 16: No. 4, 649-663(Oct 1972). (In Russian).

Mass and energy distribution of fragments in studying of fission reaction ^{235}U + $n_{ther.}$ are presented. Fragment energy was detected in a double ionization chamber with grids. The ratio peak/valley in the mass distribution, not corrected for the apparatus resolution, neutron emission and the background from accidental coincidences, comprises 360. Some deviations of the energy spectrum shape from a unimodal Gauss distribution have been found. This effect becomes considerably distinct in the symmetric fission region. Possible causes for this phenomenon are being discussed. (auth)

Nuclear Theory

Refer also to abstracts 2779, 2780, 3013, 3744, 4114, 4123, and 4137.

4220 (COO-2171-15) SINGLE-PARTICLE REMOVAL ENERGIES IN MANY-BODY THEORIES. Koltun, D. S. (Rochester Univ., N. Y. Dept. of Physics and Astronomy). 12 Sep 1972. Contract AT(11-1)-2171. 28p. (CONF-720933-5). Dep. NTIS $3.50.

From symposium on present status and novel developments in the nuclear many-body problem; Rome, Italy (19 Sep 1972).

The theoretical interpretation of single-particle removal energy spectra for nuclei which are measured in high-energy reactions, such as (p,2p), is discussed. Several theoretical definitions of single-particle energies are reviewed, including self-consistent orbital energies, centroid energies, and complex pole energies. These definitions, and their extensions, are discussed in terms of the linked-cluster perturbation theory and the Green's function theory. The relationships of the various energies to each other, to the theory of nuclear binding energies, and to the experimental removal energy spectra are explored. Examples of the applications to Brueckner theory and its modern variations are treated. (auth) (6 figures, 1 table).

4221 (ITF-72-89-P) RELATION BETWEEN THE CROSS SECTIONS FOR PHOTON REACTIONS. Zabolotnyi, M. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The relation between the cross sections for photon reactions is investigated. The range of applicability of the two-fold Weizsaecker-Williams approximation is established. (2 figures) (auth)

4222 (NP-19731) NEGATIVE PARITY STATES AND ANHARMONIC EFFECTS IN THE SPECTRA OF EVEN-EVEN VIBRATIONAL NUCLEI. Kocbach, L. (Bergen Univ. (Norway). Dept. of Physics). Dec 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

A form of intermediate-coupling unified model is used to study the effect of anharmonicity in the quadrupole vibrational motion on the low-lying negative-parity states of even-even nuclei. The energy splitting and the order of the states of negative-parity quintet 1^- to 5^- are reasonably well described. The transition to the well-deformed region is illustrated and the limitations of the model are discussed. (auth)

4223 (NP-19742) EFFECTIVE THREE-BODY PROBLEMS IN NUCLEAR REACTIONS. Bencze, Gy. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1972. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

The formal properties of effective three-body problems occurring in many-particle scattering processes are investigated in an exact three-body formalism. The three-body treatment is related to conventional nuclear reaction theory, and some aspects of introducing three-body models for direct reactions are also discussed. (auth)

4224 (RLO-1388-204) MICROSCOPIC CALCULATION OF FISSION FRAGMENT ANISOTROPIES FOR NUCLEI EXHIBITING A DOUBLE BARRIER. Vandenbosch, R. (Washington Univ., Seattle). 1972. 19p. Dep. NTIS $3.00.

At moderate excitation energies fragment angular distributions are determined by an effective moment of inertia characteristic of the saddle-point deformation. A microscopic calculation was performed which shows that at low excitation energy the experimentally deduced effective moment of inertia corresponds to the outer barrier. This is consistent with recent theoretical calculations showing that the inner barrier is unstable with respect to distortions destroying axial symmetry of the nuclear shape. At higher excitation energies the effective moment of inertia becomes characteristic of the liquid-drop-model saddle deformation. The transition is expected to occur at a fairly high excitation energy, and may provide an explanation for the observation that the effective moment of inertia continues to increase at excitation energies well above that where pairing effects have disappeared. (5 figures) (auth)

4225 CALCULATION OF THE MATRIX ELEMENTS FOR THE β TRANSITION IN THE SINGLE-PARTICLE MODEL WITH WOODS-SAXON POTENTIAL AND WHEN A TERM OF THE CORIOLIS TYPE IS PRESENT IN THE NUCLEAR HAMILTONIAN. Bogdan, D.; Cretu, T.; Macarie, Gh. (Inst. of Atomic Physics, Bucharest). Bul. Inst. Politeh. Gheorghe Gheorghiu Dej Bucuresti; 34: No. 5, 45-55(1972). (In Rumanian).

The mathematical formalism drawn up with a view to investigating the β decay of deformed nuclei is shown, using Gareev-type wave functions obtained through solving the Schroedinger equation with Woods-Saxon potential, and allowing for the Coriolis-type term. The calculation of the form factors by using this formalism allows the determination of some observables such as the form factor of the β spectrum, 1 logft, the longitudinal polarization of the β radiation, $\beta-\gamma$ correlations, etc. (1 figure) (auth)

4226 HIGH ISOSPIN STATES OF NUCLEI AND MULTINEUTRONS, AND THE SECOND REGION OF NUCLEAR STABILITY. Gol'danskii, V. I. (Inst. of Chemical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 1, 41-43(5 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 1, 56-58(5 Jan 1973).

The question of the existence or nonexistence of bound β-active multineutrons reduces to the ratio of the excitation energy of the first nuclear level with isotopic spin $T = A/2$ to the Coulomb interaction energy $E_{Coul} \simeq Q[Z(Z-1)]/A_{1/3}$ of the proton. An inequality for the existence of a multineutron is obtained. With the assumption that the forces acting in the higher-isospin states are the same as in the lower ones and that all other forces are negligible, extrapolation leads to the assertion that for any nucleus the excitation energy of the lower of the levels with isospin A/2 exceeds the sum of the total binding energy of the nucleons in this nucleus and the Coulomb-repulsion energy of its protons. Correctness of the above statement implies the nonexistence of any bound multineutrons, i.e., the impossibility of formation of neutron nuclei and drops of neutron liquid by purely nuclear

forces, and also the absence of isospin-excited nucleon-stable levels of any hydrogen isotope. It is also concluded that, even if the second region of nuclear stability does exist, it cannot be adjacent to the presently known region in any case, and can form only an "island" of superheavy isotopes of light elements. (1 figure) (RWR)

4227 USE OF THE BUEHRING–STECH–SCHUELKE THEORY TO DETERMINE THE EFFECT OF THE SECOND CLASS INDUCED TENSOR INTERACTION ON K/β^+ RATIOS. Vatai, E. ATOMKI (At. Kut. Intez.) Kozlem.; 14: No. 4, 233-237(1972).

Deduction of the correction caused by the second-class induced tensor interaction is given using the Buehring–Stech–Schuelke theory of β decay. (auth)

4228 PROBLEM OF MAGIC NUMBERS OF NEUTRON-RICH NUCLEI. Vinogradov, B. N.; Elagin, Yu. P. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 2, 250-257(Feb 1973). (In Russian).

A problem of magic numbers of neutrons in neutron rich nuclei was studied by the method of configuration interaction. When calculating the probabilities of the basic configurations, account is made of a continuous spectrum influence. (auth)

4229 INTERACTION OF POLARIZED RESONANCE NEUTRONS WITH ORIENTED NUCLEI. Alfimenkov, V. P.; Efimov, V. N.; Panteleev, Ts. Ts.; Fenin, Yu. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 17: No. 2, 293-300(Feb 1973). (In Russian).

Total cross sections for the interaction of polarized neutrons with arbitrary polarized nuclei in isolated resonance level approximation were considered. It is shown, in the case of p-levels the polarization cross section greatly depends upon the ratio of the amplitudes of neutron partial widths if there are two input channels with different spins. Possibilities to identify p-levels experimentally as well as to determine their spins and ratio of the amplitudes of neutron partial widths are discussed. (auth)

4230 NUCLEAR REACTIONS IN μ-MESOATOMS. Zaretskii, D. F.; Lyul'ka, V. A. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 17: No. 2, 271-277(Feb 1973). (In Russian).

Some singularities of development of nuclear reactions arising due to the phenomenon of radiationless transitions in heavy μ-mesoatoms are considered. (auth)

4231 INTERNAL COMPTON-EFFECT. Drukarev, E. G. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 17: No. 2, 342-354(Feb 1973). (In Russian).

An internal Compton effect at nucleus transition energies comparable with electron mass was studied. Different final states of the electron are considered. The calculations are made with the relative accuracy $(\alpha Z)^2$. (auth)

4232 ASYMPTOTICS OF RESONANCE WAVE FUNCTION FOR THREE PARTICLES. Badalyan, A. M.; Simonov, Yu. A. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 17: No. 2, 441-455(Feb 1973). (In Russian).

The asymptotics of the wave function of three-particle resonance is studied with the Faddeev uniform equation. For energy $E > 0$ the most general case, when two decay channels in the system might be open is considered: for one free particle and the bound state of two others or three free particles. (auth)

4233 PRE-EQUILIBRIUM DECAY AND THE EXCITON MODEL. Ribansky, I.; Oblozinsky, P.; Betak, E. (Inst. of Physics, Bratislava). Nucl. Phys.; A205: No. 3, 545-560(1973).

A connection between the exact and closed-form formulations of the statistical spin-independent theory of nuclear reactions in the Griffin exciton model is suggested; and its validity, discussed. It is shown that both formulations give close results if the fraction of the preequilibrium decay is not near unity. The particle–hole state density derived by Williams, including the Pauli principle, is used; and corresponding formulas for transition rates are suggested. Finally, the data of Lanzafame and Blann for the reaction $^{197}Au(\alpha,n)$ are used to determine the $|M|^2$ values for the initial particle–hole numbers $n_0 = 3$, 4, and 5. It is found that the fraction of preequilibrium decay is constant and $|M|^2$ increases with the excitation energy for $n_0 = 3$. For $n_0 = 4$ and 5 the preequilibrium fraction increases slowly with the excitation energy and $|M|^2 \approx$ const. (8 figures) (auth)

4234 VALIDITY OF THE GAUSSIAN APPROXIMATION FOR THE NUCLEAR SPECTRAL DISTRIBUTIONS IN A SOLVABLE MODEL. Quesne, C. (Univ. Libre, Brussels). Phys. Lett.; 43B: No. 6, 463-466(19 Mar 1973).

It is shown in a two-level model using either a pairing or monopole-monopole interaction that the predominance of the one-body part of the Hamiltonian over the two-body one is responsible for the occurrence of Gaussian distributions. (auth)

4235 MODIFIED BOUNDARY-CONDITION-MODEL INTERACTION. Hoenig, M. M. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys.; A206: No. 1, 169-175(1973).

A modified two-nucleon boundary-condition-model interaction is presented for which the off-energy-shell T matrix has no unphysical singularities. Numerical calculations show that the phase shifts are not appreciably affected by the modifications. (3 tables) (auth)

4236 FISSION AND DECAY OF EXCITED NUCLEI. Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR); Il'inov, A. S.; Toneev, V. D.; Gereghi, F. G. Nucl. Phys.; A206: No. 1, 131-144(1973).

The statistical theory of the decay of excited nuclei including the competition between particle emission and fission is considered. Fission barriers are given by a phenomenological formula which is an analog of the known Cameron formula and approximates well experimental data on nuclei up to transuranic elements. The contribution of shell corrections and odd–even effects is discussed. The calculated ratios of evaporation and fission widths, Γ_n/Γ_f, agree with experiment even in the region of nuclei with $Z > 90$. The Γ_n/Γ_f values depend weakly on excitation energy for nuclei with $Z \approx 90$, while in other regions this dependence proves rather strong. The last conclusion does not contradict known experimental data, since in experiments one usually measures some effective value $\langle\Gamma_n/\Gamma_f\rangle$, which is only indirectly related to the real Γ_n/Γ_f values. It is shown that the calculated values of $\langle\Gamma_n/\Gamma_f\rangle$ do not practically depend on excitation energy either. The effects of angular momentum and uncertainty in the choice of level density parameter are discussed. (10 figures, 2 tables) (auth)

4237 PHENOMENOLOGY OF THE SHELL EFFECTS IN THE COULOMB DISPLACEMENT ENERGY. Nir, D. (Hebrew Univ., Jerusalem). Nucl. Phys.; A206: No. 1, 65-75(1973).

A new form of data analysis is used to present the shell effects in the Coulomb displacement energy. Various types of differences of the quantity $A^{\frac{1}{3}}(\Delta E_c)$ are studied. The evaluated differences show a very regular behavior, which is correlated to magic numbers and to the ground state spins of neighboring nuclei. A separation between the proton effects and the neutron effects makes it possible to present a new empirical relationship between Coulomb displacement energies, which reproduced all the shell effects. (6 figures, 1 table) (auth)

4238 POSITIVE-ENERGY BOUND STATES OF NONLOCAL SEPARABLE POTENTIALS. Beregi, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A206: No. 1, 217-224(1973).

The behavior of positive-energy "bound states" of the nonlocal separable potentials in the many-channel case is investigated. It is shown that these states become resonances when the coupling between different channels is switched on. The energy dependence of the phase shift for different cases is presented. (3 figures, 1 table) (auth)

4239 LOW-ENERGY PION–NUCLEUS OPTICAL POTENTIALS. Faeldt, G. (CERN, Geneva). Nucl. Phys.; A206: No. 1, 176-192(1973).

Local and nonlocal pion–nucleus optical potentials are discussed. It is found that the local potential becomes nonlocal when two-nucleon correlations are included. The two potentials (including correlations) can be made local through a transformation on the wave function. The new local potentials agree up to quadratic terms when expanded in powers of the density. The influence of finite-range correlations and off-shell pion–nucleon form factors is also investigated. (auth)

4240 COLLECTIVE MODEL ANALYSES OF TWO-PARTICLE TRANSFER REACTIONS. Chandler, M. Minneapolis; Univ of Minnesota (1972). 131p. University Microfilms Order No. 73-10,533.

Thesis (Ph. D.).

A method is developed for calculating two-nucleon-transfer-reaction (TNTR) spectroscopic amplitudes between initial and final SU_3 wave functions that differ by either two (2s – 1d) particles or one (2s–1d) particle and one (1p) hole. The wavefunctions are classified according to the group reduction $U_6 \supset SU_3 \supset R_3$. The Wigner Supermultiplet Scheme is used for the formation of totally antisymmetric functions in the Hill–Wheeler projections. By using distorted-wave Born-approximation (DWBA) and coupled-channel Born-approximation (CCBA) reaction mechanisms, the TNTR predictions of the SU_3 and Nilsson collective formalisms

are compared with each other and with $^{20}Ne(t,p)^{22}Ne$, $^{22}Ne(p,t)^{20}Ne$, and $^{20}Ne(^3He,p)^{22}Na$ experimental data. For the ^{20}Ne and ^{22}Ne isotopes the SU_3 LS-coupled L-projected wave-functions give rise to $[sd]^2$ and $[d^2]^2$ spectroscopic amplitudes, which are coherent in the (t,p) reaction but which destructively interfere in the (p,t) case. Formally, when shell mixing is excluded, this coherence effect is absent in the Nilsson scheme; however, CCBA dilutes this difference by having the F_0 form factor dominate the reaction mechanism. Overly strong (p,t) and (t,p) strengths to members of the lowest excited positive-parity bands in ^{20}Ne and ^{22}Ne arise from the construction of Nilsson intrinsic states that are spurious with the ground-state band. The SU_3 predictions agree well with the data, and indicate both single- and two-particle excitation components in the construction of the rotating intrinsic state that describes the $K = 0^+$ 6.72 rotational band in ^{20}Ne. The CCBA results imply that the Ne ground-state band 0^+ members are populated via a one-step process, the 2^+ members via a two-step process, and the 4^+ members via both one and two-step processes. The J-projected SU_3 wave-function results are more satisfying than those given by Nilsson for the population of the #1 and #3 bands in the $^{20}Ne(^3He,p)^{22}Na$ reaction. (RWR)

4241 COMPUTER PROGRAM FOR CALCULATING EXPERIMENTAL PHOTONUCLEAR CROSS SECTIONS. Cirstoiu, B.; Deberth, C. (Inst. for Atomic Physics, Bucharest). pp 245-248 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

The basic theory and equations for calculating photonuclear cross sections are outlined. The procedures used by a FORTRAN program for cross section computation are summarized. A general flow chart for the program is included. (1 figure) (RWR)

4242 CORIOLIS ANTI PAIRING EFFECT AND ANGULAR MOMENTUM PROJECTION IN RARE EARTH NUCLEI. Faessler, A.; Lin, L.; Wittmann, F. (Kernforschungsanlage, Juelich, Ger.). Phys. Lett.: 44B: No. 2, 127-130(16 Apr 1973).

The "back bending" for the nuclei ^{160}Dy and ^{162}Er is calculated in the framework of the Coriolis antipairing (CAP) effect. Angular momentum, proton and neutron number projections are performed before the minimization of the expectation value of the total Hamiltonian with respect to the pairing degree of freedom for every angular momentum independently. The Hamiltonian is represented by the spherical shell model, pairing and quadrupole force. The trial wave functions are deformed Hartree Fock Bogoliubov (HB) states projected on to good angular momentum and on to good proton and neutron numbers. Comparison with experimental data shows a satisfactory agreement. (auth)

4243 ENERGY DEPENDENCE OF EXPECTATION VALUES IN MANY-PARTICLE SPECTROSCOPY. Chang, F. S. (Univ. of Pennsylvania, Philadelphia); French, J. B. Phys. Lett.; 44B: No. 2, 131-134(16 Apr 1973).

Expectation values, locally averaged in energy, are given, by means of parametric differentiation on the state density, in terms of Hermite polynomials in $(E-\xi)/\sigma$ where ξ and σ are the spectrum centroid and width. (auth)

4244 PARITY VIOLATING TWO-PION-EXCHANGE NUCLEON-NUCLEON POTENTIAL. Pirner, H. J.; Riska, D. O. (State Univ. of New York, Stony Brook). Contract AT(11-1)-3001. Phys. Lett.; 44B: No. 2, 151-154(16 Apr 1973).

The isovector part of the parity violating two-pion-exchange NN potential is constructed from the field theoretic amplitude. The parity violating NN coupling is described by the phenomenological Lagrangian $g_W\bar{\psi}(\tau \times \phi)_3\psi$, with $g_W = 3.2 \times 10^{-8}$. The effect of p-wave $\pi\pi$ correlations is taken into account. (auth)

4245 M1 AND E2 TRANSITIONS WITHIN LOW-LYING MULTIPLETS OF ODD-ODD NUCLEI. Evstaf'ev, N. N.; Rozantsev, I. N.; Estulin, I. V. (Mos$_{40}$ State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2567-2576(Dec 1972). (In Russian).

The recent accumulation of experimental data on the lifetimes of levels of odd-odd nuclei facilitated a systematic comparison of these data with theoretical estimates. Known M1 and E2 transitions within multiplets of the states of odd-odd nuclei with energies of up to 1 MeV for 24 isotopes were assembled into a table for purposes of discussion. (1 table) (KSW)

4246 MOMENT OF INERTIA IN THE MICROSCOPIC THEORY OF NUCLEAR ROTATION. Zelevinskii, V. G.; Shtokman, M. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2577-2584(Dec 1972). (In Russian).

Quantum corrections to the cranking model of forced rotation of the nucleus were applied in the microscopic investigation of rotational excitations. Expressions for the derivatives of the moment of inertia (J_0) were developed which agreed with the results of Marshalek [Phys. Rev., 158: 993 (1967)]. (2 figures, 1 table) (KSW)

4247 NONROTATIONAL STATES OF ODD, DEFORMED NUCLEI IN THE $179 \leq A \leq 185$ RANGE. Solov'ev, V. G.; Fainer, U. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 698-705(Apr 1972). (In Russian).

The energies and wave functions found for A = 181 were used to calculate the nonrotational states of odd, deformed nuclei in the $179 \leq A \leq 185$ range. In view of the dependence of the one-particle energy and the wave functions of the Saxon-Woods potential on the mass number, the nonrotational states of each nucleus was determined up to 2 to 3 MeV for β_{20} quadrupole and β_{40} hexadecapole deformation parameters, close to known values of the corresponding even-even nuclei. The values derived for ^{179}W, ^{181}W, ^{183}W, ^{185}W, ^{183}Os, ^{185}Os, ^{179}Ta, ^{181}Ta were tabulated; no data were available for some of these nuclei. Many of the low levels contain γ vibration phonons which increases the E2 transition probability. It was concluded that calculation of the nonrotational states of deformed nuclei on the basis of the superfluidity model of the nucleus with paired multipole-multipole forces and one-particle energy Saxon-Woods potential wave functions agree with available experimental data. The wave functions derived may be used to calculate other characteristics of the deformed nuclei. (TTT)

4248 NONADIABATIC CONSIDERATION OF ROTATIONAL BANDS IN ODD NUCLEI. Baznat, M. I.; Pyatov, N. I.; Chernei, M. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 789-797(Apr 1972). (In Russian).

The Bohr-Mottelson model, used for analyzing the spectra of the rotational states of deformed nuclei, involves study of the motion of the odd particle in the field of the axially symmetric rotator. In this connection a nonadiabatic rotational model was developed under consideration of the polarization effects and used to analyze rotational models of odd rare-earth nuclei. Results obtained with this model concerning the properties of rotational states are outlined. The influence of this Coriolis interaction and polarization effects on the rotational spectra, the magnetic moments, and the M1 transition probabilities within the rotational bands are considered. The conditions under which the energy of rotational bands based on positive parity levels in nuclei with odd N are indicated. It is concluded that the nonadiabatic effects have been considered in the theory and the small differences observed are related to differences in the density distribution of the nucleus, the effect of quadrupole oscillations of the surface of the nucleus, etc. The method does not take into account the dynamic effects due to the dependence of the collective parameters on the rotational frequency; however, the dynamic effects are weaker in odd than in even-even nuclei; therefore, the static approach may be used to describe the rotational state even in case of large spins. (TTT)

4249 NONROTATIONAL STATES OF DEFORMED NUCLEI WITH ODD NUMBERS OF PROTONS IN THE $153 \leq A \leq 177$ RANGE. Solov'ev, V. G.; Fedotov, S. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 706-717(Apr 1972). (In Russian).

The one-particle energies of the Saxon-Woods potentials were used in the calculations, considering in particular nuclei the spectra of which had not been determined previously. The nuclei of the A = 155 zone (^{153}Eu, $^{155-161}Tb$, $^{159-161}Ho$) were investigated at a quadrupole deformation of $\beta_{20} = 0.28$ and a hexadecapole deformation of $\beta_{40} = 0.06$; the nuclei of the A = 165 zone (^{163}Ho, $^{165,167,171}Tm$) were studied at $\beta_{20} = 0.28$ and $\beta_{40} = 0.02$, and the nuclei of the A = 173 zone ($^{169,173,175}Lu$, ^{177}Ta) at $\beta_{20} = 0.27$ and $\beta_{40} = -0.02$. Calculation of the nonrotational states of ^{155}Eu, ^{165}Ho, ^{169}Tm and ^{171}Lu on the basis of wave functions and Saxon-Woods potential data revealed that description of these states is only slightly improved with respect to calculations based on the Nilsson potential, and therefore these nuclei were omitted from consideration. The calculations predicted successfully the location of a large number of new levels in the investigated odd-proton nuclei within the $153 \leq A \leq 177$ range. (TTT)

4250 CHARACTERISTIC SPLITTING OF THE MULTIPLET OF THE $(j_1^{\pm 1}; j_2^{\pm 1})$ CONFIGURATION. Peker, L. K. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 913-916(Apr 1972). (In Russian).

The spectra of the multiplets of the simplest two-particle configuration $(j_1^{\pm 1}; j_2^{\pm 1})$ were investigated in order to establish the functional dependence of the experimentally obtained level energies

in the multiplet on their spins E = E(I). It was found that for each type of force, the dependence of the diagonal matrix elements on I may be given by two smooth curves for even and odd spin values. The absolute value of the diagonal matrix elements of the Wigner forces was usually much higher than the matrix elements for singlet and tensor forces. Admixture of other configurations, collective levels, etc., result in the deformation of both above-mentioned theoretical curves, shifting them with respect to each other vertically and horizontally. If a level assumed to have the above multiplet does not fall on the smooth curve, it probably does not belong to that multiplet; thus the 1300 keV, 7⁻ level of ^{210}Bi does not have the p(9/2)n(1 11/2) multiplet configuration as it has been assumed earlier. The calculations apply to all two-particle configurations, including those of even–even, not only the odd–odd, nuclei. (TTT)

4251 TENSOR FORCES IN 3- AND 4-NUCLEON SYSTEMS. Maksimenko, V. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 904-909(Apr 1972). (In Russian).

The relative value of tensor forces with respect to central forces in phenomenological nuclear potentials was considered. In order to reduce the uncertainty in the determination of the tensor potentials, the fundamental states of more complex systems, such as ^{3}H and α particles, were studied together with the deuteron. The perturbation theory was used to calculate the bond energy and the dimension of the ^{3}H and ^{4}He nuclei, choosing the wave function of the shell model derived from one-particle oscillatory functions for zero-order approximation. That function contains a dimensional parameter determined by minimizing the average value of the total energy of the system. The Brillouin–Wigner theory of perturbation was also employed. Second-order corrections were made in the perturbation theory for ^{3}H; the convergence of the series for this correction for the tensor forces was found to be worse than for central potentials. Thus, in order to improve the precision in bond energy calculations on the basis of only the lowest configuration, more unfilled states must be taken into consideration. (TTT)

4252 POSSIBILITY OF MEASURING PHASE DIFFERENCES OF THE INTERFERING STATES OF A COMPOUND NUCLEUS. Vlasov, V. G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 899-903(Apr 1972). (In Russian).

The case of two energetically overlapping resonances was considered, assuming that the final states of the nuclei and the emitted particles in the two resonances coincide. Such resonances add up coherently, and their relative phase depends only on the matrix elements. The T invariance and phases of the matrix elements and the correlation function of the two interfacing resonances were examined. The experimental determination requires the measurement of the polarization of the incident particles and of the nuclei in their initial state. P and T parity correlation functions were derived, using Legendre polynomials. The experimentally determined phase differences of the matrix elements contributed to a deeper understanding of the structure of the nucleus. (TTT)

4253 ANALYSIS OF M1 INTRANUCLEAR CONVERSION ON THE BASIS OF THE SAXON–WOODS POTENTIAL. Feresin, A. P.; Shults, G. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 890-898(Apr 1972). (In Russian).

In view of the large volume of experimental data on the magnetic properties of the nucleus and the anomalies in the internal conversion coefficients of M1 transitions, the M1 intranuclear conversions were studied in odd deformed nuclei, using a more accurate theoretical basis than in previous studies. The work involved examination of 20 M1 transitions with the rotational band ($\Delta K = 0$) on rare earth nuclei, using the Saxon–Woods potentials. It was found that the matrix elements of this conversion for transitions between levels of the various rotational bands can be described with the generalized model, using the one-particle wave function of the Saxon–Woods potential. For transitions within the rotational band, the anomalies in the internal conversion coefficients do not usually exceed 10%, except the 73.4 keV and the 113-keV M1 transitions of ^{163}Dy and ^{177}Hf, respectively. In these nuclei evaluation of structural effects is made difficult by the scarcity of good experimental data. (TTT)

4254 PARAMETRIC REPRESENTATION OF ONE-PARTICLE ENERGY STATES. Sukhoruchkin, S. I. (Inst. of Theoretical and Experimental Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 4, 885-889(870-875). (In Russian).

The information concerning distances between excited levels of complex nuclei, derived from the energy spectra of the γ radiation accompanying thermal neutron capture, may be used to develop level schemes and to check proposed models. It was thus noted that there is a tendency toward energy intervals of about 120 and 30 keV in the lower levels of many nuclei. This was attributed to the stabilizing shell effect. In order to verify the fine structure in E_γ, all precise literature data on radiative neutron capture were analyzed, presenting the results in the form of idiohistograms. The "general compensating shell effect", resulting from the neutron bond energy, was used to explain previously observed peculiarities in the bond energy intervals of one-particle nuclei. F. Everling's systematics was also used to establish correlations in the tens of keV and eV ranges. (TTT)

4255 MULTIPLET SPLITTING OF DEFORMED NUCLEI IN THE A = 150 TO 190 REGION. Neiburg, L. A.; Prokof'ev, P. T.; Tamberg, Yu. Ya. (Inst. of Physics, Riga). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2555-2563(Dec 1972). (In Russian).

Calculations of the matrix elements A_{ij} and B_{ij} were conducted for 82 pairs of single-particle states which are encountered most frequently in schemes of low-lying levels in nuclei with A = 150 to 190. The calculations were based on Nilsson's wave functions (1958) for $\eta = +6$. Tables of computed values for two-particle states of odd–odd, two-quasi-particle states of even–even, and three-quasi-particle quadruplets of odd nuclei are also presented, the first set beginning with ^{156,158,160}Tb and ending with ^{182,186,188}Re. (6 tables) (KSW)

4256 INVERSE PROBLEM OF COUPLING IN THE ROTOR MODEL OF AN ODD DEFORMED NUCLEUS. Aleksandrov, L.; Karadzhov, D.; Mikhailov, I. N.; Nadzhakov, E.; Khodzhaev, G. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2585-2596(Dec 1972). (In Russian).

The properties of the low-lying states in the rotor model of the odd nucleus are interpreted according to data on the rotational excited states of the adjacent even nuclei. It is demonstrated that it was possible to arrive at such a model beginning with the known many-particle Hamiltonian, H, the wave functions, |IM), and the corresponding energy, E_I, of the states of the ground-state rotational band for the neighboring even–even nuclei. (4 figures, 3 tables) (KSW)

4257 MAGNETIC QUADRUPOLE AND OCTUPOLE TRANSITIONS IN LIGHT NUCLEI. Dombrovskaya, G. S.; Lan'ko, E. V. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 12, 2564-2566(Dec 1972). (In Russian).

Mean strengths of $|\bar{M}|^2$ transitions and "70% widths" of the transition strength distributions had been calculated by Skorka et al [Nucl. Data, A2, No. 4 (1966)] with estimates derived from the Weisskopf formula. By using published (1972) probabilities of the electromagnetic transitions of atomic nuclei, a theory encompassing 117 M2 and 13 M3 transitions in the nuclear region Z = 1, A = 4 to Z = 30, A = 71 was developed. (1 figure, 2 tables) (KSW)

4258 GENERALIZATION OF THE ALGEBRAIC APPROACH FOR EFFECTIVE INTERACTIONS IN NUCLEI. Bhargava, P. C. (Univ. of Birmingham, Eng.). Nucl. Phys. A; A206: No. 2, 288-292(1973).

The algebraic approach of Schucan and Weidenmueller [Ann. Phys. (N. Y.), 73: 108(1972)] for effective interactions in nuclei is generalized and it is shown that in general one obtains an effective interaction which is related to that of Brandow [Rev. Mod. Phys. 39: 771(1967)] by an arbitrary similarity transformation. It is then shown how this arbitrariness can be utilized to obtain hermitian effective interactions. (auth)

4259 APPLICATIONS OF THE GROUP THERAPY OF THE HARMONIC OSCILLATOR TO PROBLEMS IN NUCLEAR PHYSICS. Turner, R. J. Toronto; Univ. of Toronto (1971). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Several models of nuclear rotation which incorporate quadrupole operators or quadrupole–quadrupole interactions are described. A group, Sp(6), is shown to be of importance in the study of the relationship of these models to each other. A new model of nuclear rotation based on a semi-direct product group $T^5 \otimes R(3)$ is briefly discussed. This model is shown to have some results in common with the Unified Model. Some aspects of the group theory of the harmonic oscillator are reviewed. A new method for obtaining the four-particle harmonic oscillator states with good angular momentum, good space symmetry, and no centre-of-mass excitation is presented. This involves the calculation of two sets of transformation brackets. These brackets enable one to express the desired states in terms of states which have a simple coefficient of fractional parentage expansion well suited for computations. These four-particle states are then used to study various quadrupole–quadrupole interactions. Special attention is paid to major shell mixing effects. The results indicate that this type of residual interaction shows a preference for U (3), or, equivalently, SU (3), symmetry. Some evidence for rotational spectra is also

noted. On the other hand, the usual quadratic radial dependence of these potentials is found to be quite inadequate even for moderate interaction strengths. Fits to the positive parity spectrum of ^{4}He are also presented. (Diss. Abstr. Int., B)

4260 IS HARTREE–FOCK SELF-CONSISTENCY IMPORTANT IN PARTICLE–HOLE CALCULATIONS? Rowe, D. J. (Univ. of Toronto). Phys. Lett.; 44B: No. 2, 155-158(16 Apr 1973).

The systematic predictable effects of self-consistency in particle–hole calculations are examined. It is shown that self-consistent radial wave functions are essential for monopole excitations and that self-consistency in deformation is vital for the quadrupole and other vibrations of deformed nuclei. (auth)

4261 APPROXIMATIONS TO CALCULATE THE MOMENT OF INERTIA IN THE PRESENCE OF RPA CORRELATIONS. Ullah, N. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; A206: No. 2, 332-342(1973).

The Thouless–Valatin formulation is used to derive an expression for the moment of inertia when RPA correlations are present. It is shown that one gets the RPA cranking-model approximation if the elements of the RAP matrix B are much smaller than A. The exactly solvable model of Lipkin, Meshkov, and Glick [Nucl. Phys., 62: 188(1965)] is used to check the validity of the oscillator-projection approximation in the calculation of the moment of inertia parameter. The model is further used to check the validity of a constrained variational calculation to calculate the moment of inertia when the square of the total angular momentum is assumed to have some given value. (2 tables) (auth)

4262 SOLUTION OF THE INVERSE REACTION PROBLEM FOR COMPLEX POTENTIALS. Bertram, W. K.; Cook, J. L. (Australian Atomic Energy Commission Research Establishment, Sutherland, New South Wales). Aust. J. Phys.; 26: No. 1, 1-5 (Feb 1973).

A method is given for solving the inverse reaction problem to obtain complex potentials as in the optical model of the nucleus. The method reproduces reaction data to the accuracy with which the reaction matrix can be least squares fitted to a sum of simple poles. The method couples multichannel phase shifts in such a way as to give the correct complex single-channel phase shift. (auth)

4263 DISTRIBUTIONS OF TOTAL α-WIDTHS OF NEUTRON RESONANCES. Popov, Yu. P. (Joint Inst. of Nuclear Research, Dubna, USSR); Rumi, R. F.; Pshitula, M.; Stempin'ski, M. Acta Phys. Pol., B; B4: No. 2, 275-285(1973). (In Russian).

By using the Monte Carlo method, it is shown that the distributions of total α widths may be reasonably described by the χ^2 distribution. The number of degrees of freedom for this distribution is given in terms of the potential barrier transmission coefficients for α-decay channels. The possibility of spin assignment for some neutron resonances for the total α-width distribution is pointed out. (5 figures, 1 table) (auth)

4264 DERIVATION OF THE STATISTICAL MODEL OF NUCLEAR REACTIONS FROM THE THEORY OF STATIONARY IRREVERSIBLE PROCESSES. Weidlich, W.; Dietel, K. (Univ., Stuttgart). Nucl. Phys.; A205: No. 2, 367-384(1973).

Nuclear reactions via a compound nucleus are considered as an example of the quantum theory of stationary irreversible processes. A density matrix formalism with Liouville space methods is developed, including in a natural way the dynamical and statistical aspects of nuclear reactions. For densely spaced compound levels the statistical model is obtained as a limiting case. (auth)

4265 SENSITIVITY OF ALLOWED β-DECAY TO THE NUCLEAR RADIUS. Wilkinson, D. H. (Oxford Univ.). Nucl. Phys.; A205: No. 2, 363-366(1973).

The sensitivity to the nuclear radius of the phase-space factor for allowed β-decay is investigated as a function of energy release and Z for $Z < 40$ using a definition of the phase-space factor that takes into account in detail finite-size effects on the lepton wave functions and their convolution with the nucleon wave functions. (auth)

4266 NEW APPROACH TO THE EFFECT OF RECOIL ON SINGLE PARTICLE TRANSFER IN DIRECT REACTIONS. Elbaz, E.; Meyer, J.; Nahabetian, R. S. (Univ., Lyon). Nucl. Phys., A.; A205: No. 2, 299-304(1973).

A new approach to the effect of recoil in single-particle transfer in direct reactions is outlined. Since no hypothesis is made on the relative masses involved and since any wave function of the transferred particle can be used, a way of exactly treating the effect of recoil in any direct nuclear reaction is presented. The radial integral becomes a two-fold integral while the geometrical structure of the result is easily obtained. (auth)

4267 NEUTRON MATTER WITH A RELATIVISTIC ONE-BOSON EXCHANGE POTENTIAL. Bleuler, K.; Erkelenz, K.; Holinde, K.; Machleidt, R. (Univ., Bonn). Nucl. Phys.; A205: No. 2, 292-298(1973).

The neutron matter properties are studied with our relativistic OBEP derived from covariant perturbation theory and represented in momentum space and helicity state basis. The short-range correlations are treated in the lowest-order Brueckner theory using the angle-averaged Pauli operator, the effective-mass approximation for the self-consistent hole state potential and a free-particle spectrum. The results are compared with those corresponding to other potentials. (auth)

4268 TENSOR FORCE AND COLLECTIVE EXCITATIONS IN NUCLEAR MATTER. Clement, D. M. (Univ. of California, Los Angeles). Nucl. Phys.; A205: No. 2, 398–412(1973).

The formalism for the particle-hole Green function is developed to handle the nucleon-nucleon tensor potential in order to investigate both the ring correlation energy and collective excitations in nuclear matter. The formalism is exact for direct ring diagrams. An approximation for exchange ring diagrams is also introduced. The one-pion-exchange potential with cut-off radius is used throughout. No collective excitations are found coming from the tensor force. (auth)

4269 INTERNAL CONVERSION OF HIGHER SHELLS. Koever, A. Atomki (At. Kut. Intez.) Kozlem.; 14: No. 4, 283-298(1972). (In Hungarian).

The early calculations of the internal conversion coefficient (ICC) are reviewed: the nucleus was assumed to consist of a point, thereby rendering the coefficient independent of the various nuclear models. The differences between the theoretical calculations and the experimental values were explained by considering a nucleus with a finite size; this step resulted in new matrix elements, which in forbidden transitions make considerable contributions to the ICC. Later studies took the shielding effect of the electrons in the inner shells into account. The value of the shielding correction was also checked independently of the ICC on the basis of theoretical and experimental binding energies, varying the blowup factor. Changes in the atomic wave functions may affect the transition probability of certain types of decay, such as electron capture and internal conversion. Change of the internal conversion probability may be used to study the chemical bond and the chemical nature of implanted ions. Its most important application is the clarification of the Moessbauer isomer shift and the charge radius of the nucleus. (Review article, 4 figures, 6 tables, 32 references) (TTT)

4270 ANALYSIS OF ELECTRON SCATTERING EXPERIMENTS. Method and Critical Study. Berthot, J.; Isabelle, D. B. (Univ., Clermont-Ferrand, France). Rev. Phys. Appl.; 7: No. 4, 413-426(Dec 1972). (In French).

A method used to analyse scattered electron spectra without involving any nuclear model is described. Measurements were carried out to establish the validity of the formulas obtained. (FR)

4271 MATRIX ELEMENTS FOR SPIN CURRENT TRANSITIONS IN THE INELASTIC ELECTRO-EXCITATIONS OF NUCLEI BY USING DIFFERENT VECTOR POTENTIAL DECOMPOSITIONS. Joenperae, I. Ann. Acad. Sci. Fenn., Ser. A VI; No 397, 1-34 (1972).

The object of the investigation was to obtain the reduced electric, magnetic as well as Coulomb transition matrix elements using single-particle calculations for a fixed momentum transfer, k. The different decompositions of the vector potential presented by Eisenberg and Greiner, Rose, and Foldy were compared. The validity of Siegert's theorem in electro-excitations was examined, and main differences between the real photon and virtual photon excitations are discussed. (FI)

4272 FISSION IN NUCLEAR REACTION THEORY. Lynn, J. E. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., A (London); 6: No. 4, 542-569(Apr 1973).

Nuclear fission is incorporated in a formal way into the R-matrix reaction theory. Definitions of suitable variables to describe fission deformation in terms of individual nucleon coordinates are described first of all. The kinetic energy operator of the many-particle Schroedinger equation is then cast into a form that explicitly displays its dependence on the new fission deformation variable. A term in the potential energy that similarly displays a dependence only on the fission deformation variable is then defined, and so the Hamiltonian is broken up into a deformation term, an "intrinsic" term (depending on the other degrees of freedom) and a coupling term. This break-up allows the definition of fission channels; with the choice of channel boundaries close to maxima in the fission potential energy curve

these correspond physically to A. Bohr's more intuitive definition of fission channels. This formalism is applied to the treatment of the intermediate structure in fission reactions that appears to be a result of the secondary well in the fission potential barrier. A development of the formalism is also made in which an intermediate region of configuration space is introduced, in addition to the usual internal and channel regions that normally appear in R-matrix theory. If this intermediate region is defined to include the secondary well of the barrier, the dispersion effects that correspond to intermediate structure appear in the extended penetration and shift factors (the logarithmic derivative of the outgoing waves in the fission channel) rather than in the R matrix of the internal region. This allows a particularly simple treatment of the so-called vibrational resonances of fission reactions. (auth)

4273 DISPERSION RELATIONS AND LOW-ENERGY ELASTIC SCATTERING OF CHARGED PARTICLES FROM NUCLEI. I. Theory. Viollier, R. D.; Plattner, G. R.; Trautmann, D.; Alder, K. (Univ., Basel). Nucl. Phys.; A206: No. 3, 498-512(1973).

Dispersion relations for the elastic scattering of charged particles by nuclei are deduced for the case of potential scattering. The inclusion of the Coulomb interaction leads to a simple modification of the formalism developed so far for uncharged projectiles only. (2 figures) (auth)

4274 LINKED-CLUSTER THEOREM IN FINITE MODEL SPACES. Mavromatis, H. A. (American Univ. of Beirut, Lebanon). Nucl. Phys.; A206: No. 3, 477-480(1973).

It is pointed out that the linked-cluster expansion and the Rayleigh–Schroedinger perturbation (for a nondegenerate system) are not identical in a finite model space. Judging from some calculations the complete Rayleigh–Schroedinger expansion appears to be more accurate than evaluating only linked graphs in a finite model space. (4 figures, 1 table) (auth)

4275 ISOVECTOR MONOPOLE STATE AND THE ESCAPE WIDTH OF DOUBLE ANALOG RESONANCES. Lev, A.; Auerbach, N. (Tel-Aviv Univ., Israel). Nucl. Phys.; A206: No. 3, 563-572(1973).

An irreducible vector operator is used to generate isovector monopole states with well-defined values of T and T_z in N > Z nuclei. Reduced transition strengths are calculated in two different ways and the results seem compatible. The Wigner–Eckart theorem is used to derive expressions for the mixing of the monopole states with the ground state and its analog states. Expressions for the escape widths of the monopole states are also derived. An application is made to double analog resonances; and it is found, contrary to expectations, that the mixing with the T – 1 monopole state is unable to account for the observed elastic partial width of these resonances in medium and heavy nuclei. The reason for this is the small escape width of the monopole state. (2 tables) (auth)

4276 FINE STRUCTURE IN DELAYED-PROTON SPECTRA. Karnaukhov, V. A.; Bogdanov, D. D.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys.; A206: No. 3, 583-592(1973).

The fine structure in delayed-proton spectra is interpreted on the basis of statistical fluctuations associated with the variation of β-decay matrix elements and the relative proton widths of the excited states. Formulas are derived which give the variance of relative proton intensity in terms of the average characteristics of the delayed proton emission and the level density. The experimental data on the variance of the relative proton intensity for ^{111}Te and the calculations using these formulas are in satisfactory agreement. The fluctuations predicted for ^{109}Te considerably exceed the measured ones. (6 figures) (auth)

4277 CONTRIBUTIONS TO THE MOESSBAUER LINE SHAPE IN COUPLED HYPERFINE INTERACTIONS. Barb, D.; Constantinescu, S.; Diamandescu, L.; Tarina, D. (Inst. for Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 7, 769-775(1972).

Mixed nuclear wave functions determined by the coupled hyperfine interactions are used in the Blume's stochastic solution of the Moessbauer line shape when the terms of the nuclear Hamiltonian do not commute with one another. The contribution of the mixing coefficients to the line shape is discussed. (auth)

4278 SELF-CONSISTENCY OF THE TWO-CENTERED OSCILLATOR MODEL IN THE FISSION THEORY. Morozov, D. F.; Cherdantsev, P. A. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 1, 104-110(1973). (In Russian).

A comparison was made of the potential of a two-centered oscillator with a finite potential. At small deformations agreement was observed in the behavior of potentials. A self-consistency procedure was fulfilled within the framework of the model indicated. (tr-auth)

4279 INTERPOLATION OF TABULAR SECONDARY NEUTRON AND PHOTON ENERGY DISTRIBUTIONS. Doyas, R. J.; Perkins, S. T. (Univ. of California, Livermore). Nucl. Sci. Eng.; 50: No. 4, 390-492(Apr 1973).

The consequences of using three different interpolation methods for tabular neutron and photon energy distribution data are investigated. The three methods are linear interpolation on energy, linear interpolation on energy after the secondary energy ranges are transformed to unit base, and linear interpolation on energy after the initial distributions are converted to cumulative probability distributions by integration over the secondary neutron or photon energy. The latter two methods may subsequently be reconverted to differential probabilities. Linear interpolation on energy without transformation or conversion is shown to be the least desirable for most applications. (auth)

4280 HYPERSPHERICAL-EXPANSION APPROACH TO NUCLEAR BOUND STATES. V. The Limit of Large A for Nonlocal Potentials. Calogero, F. (Univ., Rome); Olivieri, E.; Scalia, M.; Ragnisco, O.; Simonov, Yu. A.; Surkov, E. L. Nuovo Cim.; 14A: No. 13, 477-500(1 Apr 1973).

A closed-form expression providing an upper bound (lower bound in modulus) for the energy per particle in balanced nuclear matter is obtained, starting from the hyperspherical-expansion approach to nuclear bound states, and considering nonlocal two-body nuclear potentials. This formula is compared with the analogous expression that obtains in the standard Fermi-gas treatment; numerical results for the potentials of Tabakin and of Hamman and Ho-Kim are reported and discussed. Some of the formulas given are also of value to recast results given in previous papers of this series in a more convenient form. (auth)

4281 INTERPRETATION OF HIGH-ENERGY INCLUSIVE SCATTERING DATA OF HADRONS ON NUCLEI. Kofoed-Hansen, O. (CERN, Geneva). Nucl. Phys.; B54: No. 1, 42-60(1973).

Formulas are established for the description of momentum-loss spectra for high-energy scattering of hadrons on nuclei. A very simple calculation of macroscopic multiple scattering on an extended hydrogen target introduces the reader to the basic picture of the momentum-loss spectra. This picture is then extended to include the Glauber formalism in the region of four-momentum transfer squared q^2 where one is well outside the diffraction region. This means that validity of the picture can only be expected when elastic scattering can be neglected. One also assumes that the nuclear mass A is so large that recoil effects can be neglected. First the momentum-loss spectra are computed in the usual approximations: saddle-point integrations, product wave functions, exponentiation of factors close to one, etc. Next the saddle-point integrations are replaced by more correct procedures, the effects of the Pauli principle are examined and as the last point hard-core correlations are considered in a very rough approximation. Finally a summary is given of the most important sources of errors in the interpretation. (auth)

4282 MICROSCOPIC TREATMENT OF COLLECTIVE MOTION OF QUADRUPOLE DEFORMATION. Ogura, H. (Osaka City Univ.). Nucl. Phys.; A207: No. 1, 161-176(1973).

It is shown, by methods of group theory, that collective motions in the β and γ directions can be projected out from an intrinsic state. The group SL(3,R) is found to have a Casimir operator similar to the kinetic energy of the Bohr Hamiltonian. On the basis of this fact, a particle Hamiltonian and wave function are introduced, which take the place of those of the Bohr model. The wave function $\Psi(x)$ is given by a Hill–Wheeler integral over a certain intrinsic state $\phi(x)$: $\Psi(x) = \int F(a)\phi(a^{-1}x)da$, $a \in SL(3, R)$. The generator function F(a) is constructed by the superposition of approximate eigenfunctions of the Casimir operator. (1 figure) (auth)

4283 NUCLEAR PHYSICS: AN INTRODUCTION. Second Edition. Burcham, W. E. London; Logmman (1973). 686p.

The subject is covered in sections: introduction (the fundamental particles, their interactions and the conservation laws); natural radioactivity and the discovery of the nucleus (radioactive radiations and their properties); atomic theory and radiation (Schroedinger equation); nuclear effects in spectroscopy (effects in optical, microwave and radiofrequency spectroscopy); general properties of ionizing radiations (collisions between particles, passage of charged particles through matter, interaction of electromagnetic radiation with matter); nuclear detectors (detecting instruments); measurement of energy and intensity of ionizing

radiations (charged particles, neutrons, photons); acceleration of charged particles to high energies (high voltage d.c. accelerators, linear accelerators, orbital accelerators 1930 to 1953, alternating gradient (strong focusing) accelerators); nuclear models, the nuclear ground state and the nuclear level spectrum; the mass and isotopic abundance of nuclei; nuclear charge, nuclear moments; radiative processes in nuclear physics; nuclear reactions; radioactive decay; nuclear orientation; nuclear forces; particle physics (non-strange particles and strange particles; theories (electromagnetic interactions, weak interactions, strong interactions). (UK)

4284 HYPERSPHERICAL-EXPANSION APPROACH TO NUCLEAR BOUND STATES. IV. The Limit of Large A for Velocity Dependent Potentials. Calogero, F. (Univ., Rome); D'Andrea, A.; Olivieri, E.; Scali, M.; Ragnisco, O.; Simonov, Yu. A.; Surkov, E. L. Nuovo Cim.; 14A: No. 3, 445-476(1 Apr 1973).

The first approximation of the hyperspherical-expansion approach to nuclear bound states is discussed in the limit of large A. For velocity-independent potentials, the results given in a previous paper are rederived in a more explicit and straightforward fashion, and a more complete discussion of the next-to-leading terms in the asymptotic formula for the binding energy is given. For velocity-dependent potentials similar results are obtained. The density distribution that obtains in this treatment is exhibited and discussed. A comparison with the analogous formula for the binding energy per nucleon that obtains in the Fermi-gas treatment of nuclear matter is made, including the presentation of numerical results for the potential of Nestor, Davies, Krieger and Baranger. (auth)

4285 TRANSFER REACTIONS ON DEFORMED NUCLEI. Dumitrescu, O. (Inst. of Atomic Physics, Burcharest). Rev. Roum. Phys.; 18: No. 2, 225-255(1973).

Transfer reactions are analyzed in the context of the general theory of scattering by applying the projection procedure in the sense of Feshbach and Weidenmueller. The generalized optical model potentials for both elastic and inelastic channels are obtained in terms of a renormalized residual interaction. The known approximations and techniques for the scattering state vector, such as DWBA, coupled-channels, and the adiabatic theory are discussed and illustrated by some numerical examples. (8 figures, 3 tables) (auth)

4286 VALIDITY OF CLASSICAL ESTIMATES OF THE DYNAMICAL COULOMB BARRIER IN HEAVY-ION COLLISIONS. Londergan, J. T.; McVoy, K. W. (Univ. of Wisconsin, Madison). Nucl. Phys.; A207: No. 1, 216-224(1973).

Several recent classical estimates of the effective Coulomb barrier height in heavy-ion collisions have approximated the dynamic deformations of the nuclei as entirely classical (non-quantized) surface oscillations, weakly coupled to the ion trajectories. An examination of the validity of this approximation shows it to be quite reliable when the surface oscillations are small and harmonic. (auth)

4287 THEORY OF PARTICLE AND HOLE TRANSFER IN ELASTIC NUCLEUS–NUCLEUS SCATTERING. Von Oertzen, W. (Max Planck-Institut fuer Kernphysik, Heidelberg); Noerenberg, W. Nucl. Phys.; A207: No. 1, 113-139(1973).

The optical model description of elastic nucleus–nucleus scattering is generalized to include the transfer of particles and holes in collisions between heavy nuclei which differ only by one of a few nucleons. An elementary model which consists of two identical cores and a valence particle is solved for small valence-particle masses in the molecular two-state approximation. The molecular states of the valence particle are constructed by a linear combination of nuclear orbitals (LCNO). In order to get around the problem of Coriolis coupling the scattering solution is restricted to cases where nuclear states with $j \leq \frac{1}{2}$ or $l = 0$ are involved. Because of the possible exchange of the valence particle between the two identical cores, even and odd partial waves are scattered by different potentials. The difference is due to exchange potentials which are associated with the molecular states of definite core-permutation symmetry. The result is a characteristic interference pattern in the angular distribution of the elastic cross section. The elementary model is generalized by describing the cores in the framework of Hartree–Fock theory. This description shows that holes can be exchanged like particles. The derivation of an optical core–core potential is given. The exchange potential, which is real in the elementary model, becomes complex in the general treatment. For the elastic transfer of two particles, two holes, or a particle and a hole, four possible approximations are discussed. Correlations between core particles and valence particles or holes can approximately be taken into account by spectroscopic factors in the exchange potentials. (9 figures) (auth)

4288 TARGET EXCITATIONS AND THE OPTICAL POTENTIAL FOR PROTONS SCATTERING FROM NUCLEI. Rao, C. L. (Univ. of Tennessee, Knoxville); Reeves, M. III; Satchler, G. R. Nucl. Phys.; A207: No. 1, 182-208(1973).

The contributions to the optical potential for 30-MeV protons due to inelastic excitations of the target nucleus are calculated. The scattering due to this nonlocal potential is calculated exactly, and some of the results are subjected to conventional optical-model analysis. When only one excited state is included, a resonant dependence on the excitation energy is observed. Even with ten excited states, the position of a single one can strongly influence the scattering. It is possible to account for about $\frac{3}{4}$ of the observed absorption in ^{40}Ca and ^{208}Pb, but only by postulating unobserved states which exhaust the remainder of the experimental sum rules at somewhat unreasonably low energies. It was not possible to find simple local potentials which gave the same scattering because of the strong L dependence of the absorption. The constructed potentials concentrate the absorption at too small radii. It is suggested that rearrangement (pickup) processes contribute a substantial amount of absorption at larger radii, while compound formation will give rise to a volume term in the imaginary potential. (12 figures, 5 tables) (auth)

4289 RIGID ASYMMETRIC ROTATOR AND NUCLEUS DEFORMATION. Fedorov, A. D.; Knyr, V. A. (Khabarovsk Polytechnic Inst., USSR). Yadern. Fiz.; 16: No. 4, 670-676(Oct 1972). (In Russian).

The influence of atomic nucleus deformation upon the probability of electric quadrupole transitions and the quadrupole moments of the first excited 2^+ states is considered in the framework of the model of asymmetric rotator with modified inertia moments. In the case of spherical (or almost spherical) nuclei ($\beta_{eff} \to 0$) the calculation results correspond to the predictions of Davydov–Filippov model. An account for nucleus deformation leads to difference between the results and predictions of this model. This difference becomes very noticable in the range $\gamma \gtrsim 30°$, where theoretical energy ratios R_{22} may take the values less than two. (auth)

4290 INVESTIGATION OF VARIOUS TYPES OF REFINEMENT IN A SHELL-MODEL APPROACH TO GAMOW–TELLER β-STRENGTH FUNCTIONS. Randrup, J. (Univ., Aarhus, Denmark). Nucl. Phys.; A207: No. 1, 209-215(1973).

The β_{GT} strength functions, obtained from a simple inclusion of a residual Gamow–Teller force in the spherical shell model (with pairing), are investigated. The rather small importance of various types of refinement makes it possible to obtain easily a first rough idea of possible shell structure in the β-strength functions. Some illustrations are shown for ^{116}Xe. (3 figures) (auth)

4291 NUCLEAR STRUCTURE EFFECTS IN ALPHA-ACCOMPANIED FISSION. Carjan, N. (Joint Inst. for Nuclear Research, Dubna, USSR); Pashkevich, V. V.; Sandulescu, A. Rev. Roum. Phys.; 18: No. 2, 151-163(1973).

Alpha particle-formation probability on the surface of the fissioning system, at different moments during thermal-neutron fission of ^{235}U and spontaneous fission of ^{252}Cf, is computed in the point alpha particle approximation, R-matrix theory. The variation with the channel surface and with the position on the channel surface is given. The results obtained afford a qualitative explanation of the angular distribution, including the existence of polar emission, of the alpha particles accompanying the fission process. (6 figures, 1 table) (auth)

4292 DYNAMICS OF FISSION: THE ROLE OF REFLECTION ASYMMETRY IN THE NUCLEAR SHAPE. Ledergerber, T.; Pauli, H. C. (Univ., Basel). Nucl. Phys.; A207: No. 1, 1-32 (1973).

For nuclei in the actinide region the cranking model is used to calculate the tensor of effective mass, which has six independent components for three shape degrees of freedom—among them is the reflection asymmetry. With these mass parameters and the Strutinsky deformation energy the lifetimes for spontaneous fission are caluclated in WKB approximation. The theory does not contain ad hoc parameters. Asymmetric fission is favored; the most probable mass division (peak-to-peak ratio) agrees with the experimental data. The lifetimes for spontaneous fission from the ground state agree with the experimental data by order of magnitude. The experimental lifetime for isomer fission is also reproduced and a slower de-excitation of the isomer through the first well is obtained. The results give support to the interpretation of the fission isomers as shape isomers and the validity of the adiabatic assumption. (16 figures, 1 table) (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

Confinement and Heating

4293 (CONF-730315-8) ADIABATIC COMPRESSION OF THE TOKAMAK DISCHARGE. Bol, K.; Ellis, R. A.; Eubank, H.; Furth, H. P.; Jacobson, R. A.; Johnson, L. C.; Mazzucato, E.; Stodiek, W. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. Contract AT(11-1)-3073. 4p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The principle of adiabatic compression in a static toroidal field was successfully tested in the ATC tokamak. The toroidal field B_T was operated chiefly at ¾ of its design value, and prior to some recent modifications of the compression circuit the highest current compatible with full compression was about 75 kA. Typical plasma parameters before compression are: $I_p \sim 60$ kA, $\overline{T}_i \sim 200$ eV, T_e(peak) $\lesssim 1$ keV, $\bar{n}_e \sim 1\text{-}2.10^{13}$ cm^{-3}; after compression: $I_p \sim 130$ kA, $T_i \sim 600$ eV, T_e(peak) ~ 2 keV, and $\bar{n}_e \sim 10^{14}$ cm^{-3}. Peak electron temperatures of 2.5 keV were measured. Ion temperature increases are described. (MOW)

4294 (CONF-730315-9) SIMULATION OF TOKAMAK CONFINEMENT PROBLEMS ON FM-1. Chen, K.; Meade, D.; Okabayashi, M.; Schmidt, J. A.; Yoshikawa, S. (Princeton Univ., N. J. Plasma Physics Lab.). [nd]. Contract AT(11-1)-3073. 4p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Plasma confinement was studied in FM-1 with magnetic configurations and plasma parameters that simulate microstability properties of tokamaks. The near-classical (pseudoclassical) confinement in the spherator mode of FM-1 becomes Bohm-like ($\tau \simeq 300\tau_B$) when T_e is increased. Increasing the toroidal field by a factor 4 to simulate a tokamak configuration causes the confinement to decrease by a factor of ~5 with $\tau \lesssim 60\tau_B$. Confinement time diagrams are described. (MOW)

4295 (CONF-730315-10) HYDROMAGNETIC WAVE HEATING OF TOKAMAK PLASMAS. Perkins, F. W.; Chance, M.; Kindel, J. M. (Princeton Univ., N. J. Plasma Physics Lab.). [nd]. Contract AT(11-1)-3073. 4p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The advantages of rf heating of tokamak plasmas over neutral beam injection methods are discussed. The ion-cyclotron frequency range is considered attractive because linear wave damping processes are available to heat the ions and in the large tokamaks, the torus can become a resonant cavity for the fast magnetosonic wave at the ion-cyclotron frequency. Wave propagation kinetics are described. (MOW)

4296 (CONF-730315-11) CONFINEMENT OF PARTICLES AND ENERGY IN TOKAMAK PLASMAS. Hinnov, E.; Dimock, D.; Johnson, L. C.; Meservey, E. (Princeton Univ., N. J.). 1973. Contract AT(11-1)-3073. 4p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

Measurements of plasma particle and energy confinement times and other parameters are reported for the recently increased range and duration of the ohmic heating current in the ST Tokamak. (auth)

4297 (CONF-730315-13) INTERNAL RING EXPERIMENTS AT PRINCETON PLASMA PHYSICS LABORATORY. Yoshikawa, S. (Princeton Univ., N. J. Plasma Physics Lab.). [nd]. Contract AT(11-1)-3073. 7p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

The FM-1 spherator is briefly described. Some density profile measurements and plasma confinement time versus electron temperature diagrams are described. Comparisons were made for two different magnetic field configurations. (MOW)

4298 (N-73-10703) HEAVY ION PLASMA CONFINEMENT IN AN RF QUADRUPOLE TRAP. Schermann, J. P.; Major, F. G. (National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center). Jul 1971. 35p. (NASA-TM-X-65719; X-524-71-343). NTIS.

The confinement of an electron-free plasma in a pure quadrupole rf electric trap was considered. The ultimate goal was to produce a large density of mercury ions in order to realize a trapped-ion frequency standard using the hyperfine resonance of $^{199}Hg^+$ at 40.7 GHz. An attempt was made to obtain an iodine plasma consisting of equal numbers of positive and negative ions of atomic iodine; the positive iodine ions, being susceptible to charge exchange with mercury atoms, will produce the desired mercury ions. The experiment showed that the photoproduction of ions pairs in iodine, using the necessary uv radiation, occurs with a small cross section, making it difficult to demonstrate the feasibility of space-charge neutralization in a quadrupole trap. For this reason it was considered expedient to choose thallium iodide, which has a more favorable absorption spectrum (in the region of 2000 to 2100 A). The results indicate that, although the ionic recombination is a serious limiting factor, a considerable improvement can be obtained in practice for the density of trapped ions, with a considerable advantage in lifetimes for spectroscopic purposes. The ion pair formation by photoionization is briefly reviewed. (auth)

4299 (NP-19730) HEATING OF A TOKAMAK PLASMA TO IGNITION TEMPERATURES BY CURRENT-DRIVEN TURBULENCE. Rijnhuizen Report 73-76. de Kluiver, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Mar 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of heating a plasma (density $n_p \approx 10^{20}$ m^{-3}) in a tokamak-type toroidal machine to ignition temperatures ($T_e \approx T_i \approx 10$ keV) by means of strong turbulence induced by strong currents is envisaged. By strong turbulence is meant the excitation and subsequent thermalization of nonlinear acoustic and electron plasma waves that arise when the electron drift velocity exceeds the ion-acoustic velocity by the action of high electric fields parallel to the toroidal magnetic field. This "exercise" is performed for two somewhat different Tokamaks, the radii, field strengths, etc., having been suggested by L. Enriques. The parameters obtained for the plasma heating are a result of the extension of various scaling laws into a region unexplored as yet. (auth)

4300 (NP-19734) PROPOSAL FOR PREFERENTIAL SUPPORT. Project: Turbulent Heating of a Toroidally Confined Plasma by High Electric Fields. Rijnhuizen Report 73-75. Piekaar, H. W.; de Groot, B.; de Kluiver, H. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma Fysica). Mar 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

It is proposed to turbulently heat a toroidal plasma of density 10^{19} to 10^{20} m^{-3} by inducing strong electric fields (25 to 50 kV/m) during 1 μs. The plasma will be created by discharging a slow capacitor bank in the copper shell surrounding the quartz torus. The plasma will be contained by a toroidal magnetic field of 2 T. The strong electric fields will be realized by connecting a capacitor bank charged up to 50 kV at four gaps in the copper shell. In this way the actual voltage on the plasma may be four times larger than without such sectioning. When the plasma is heated sufficiently the bank will be crowbarred with a metal-to-metal switch. It is calculated that the inductances are such that the plasma current will flow for at least 100 μs. The heating efficiency, the ion and electron temperatures, the plasma resistivity, and the radial current distribution as a function of time will be of prime interest. Moreover, the containment and the stability of the heated plasma for a range of $B_{poloidal}$ and q may be studied. (auth)

4301 (ORNL-TM-4153) HIGH-β BEHAVIOR IN A CANTED MIRROR. Dandl, R. A.; Eason, H. O.; England, A. C.; Sprott, J. C. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 34p. Dep. NTIS $3.75.

A high-β hot-electron plasma was studied in an asymmetric magnetic mirror device with a variable cant angle. The plasma was produced by microwave heating at a frequency corresponding to cold-electron-cyclotron resonance together with a higher frequency suitable for upper-off-resonance heating. The position of the high-β plasma annulus was studied as a function of cant angle and was found to correspond approximately to the position of a midplane modulus-B contour. High-β effects did modify the spatial location of the losses of energetic electrons into the loss cone but had little effect on the cold-plasma losses. Destabilization was not observed when the line tying of the plasma center was reduced with glass end plates. An asymmetry of the cold-plasma loss with respect to the equatorial plane was observed at small cant angles and an electric field model was conjectured to explain this behavior. (auth)

4302 CONCENTRIC CONDUCTION-TYPE LASER HEATING OF D-T PLASMA. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 1, 37-43(1973).

The problem considered is that of conduction-type laser heating of D–T plasma in a concentric system. Some solutions to this problem are obtained, a closed-form, asymptotic solution, in particular, enabling one to appraise the degree of thermal cumulation in plasma. In conclusion, analogous equations are found for two-temperature plasma taking into consideration the recovery of energy of nuclear fusion. Owing to complicated nonlinearities these equations cannot be solved in so simple a manner as was done in the former case. Their numerical analysis (based among other methods on the approximate method of "central chords") will be treated separately in the near future. (auth)

4303 ROLE OF STIMULATED COMPTON SCATTERING IN THE INTERACTION OF LASER RADIATION WITH A SUPER-DENSE PLASMA. Krasyuk, I. K.; Pashinin, P. P.; Prokhorov, A. M. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 92-94(20 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 2, 130-132(20 Jan 1973).

Earlier studies have shown that, in the presence of a plasma moving opposite to the laser beam, the fraction of the reflected light energy can reach a noticeable value. The resultant opposing wave interacts during the stimulated Compton scattering with the intense incident wave and is noticeably amplified. At sufficiently high radiation fluxes, the energy of the incident wave is effectively converted into reflected-wave energy. Some equations describing this process are discussed. (MOW)

4304 EXPERIMENTS ON THE CONTAINMENT OF AN ALKALI PLASMA IN A CORRUGATED MAGNETIC FIELD. Budker, G. I.; Danikov, V. V.; Kruglyakov, E. P.; Ryutov, D. D.; Shun'ko, E. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 81-84(20 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 2, 117-120(20 Jan 1973).

Experiments were performed to verify the plasma-containment efficiency in such a magnetic-field configuration. The investigations were performed on a low-temperature alkali plasma. The vacuum chamber of the installation was a stainless-steel tube 249 cm long with inside diameter 6 cm. The chamber was evacuated by two magnetic-discharge pumps to $p \sim 2 \times 10^{-7}$ torr. Probe measurements are described. (MOW)

4305 INTERACTION BETWEEN A HIGH-FREQUENCY MAGNETIC FIELD AND POTENTIAL PLASMA OSCILLATIONS IN A Q DEVICE. Artsimovich, L. L.; Ivanov, A. A.; Luk'yanchuk, A. N.; Papernyi, V. L.; Rusanov, V. D.; Sobolev, S. S. Zh. Eksp. Teor. Fiz.; 64: No. 2, 463-470(Feb 1973). (In Russian).

In order to reduce plasma diffusion in a Q device, an hf magnetic field is applied to the plasma column. The oscillation spectra under such conditions are studied. The spectra in the presence or absence of the hf field are compared theoretically and experimentally. The effect of oscillations on diffusion are considered for both cases. (auth)

4306 NUMERICAL STUDIES OF CHARGED-PARTICLE TRAPPING IN A TIME-VARYING MAGNETIC MIRROR FIELD. Kapetanakos, C. A.; Trivelpiece, A. W. (Univ. of Maryland, College Park). Plasma Phys.; 15: No. 4, 317-322(Apr 1973).

Results of studies of the trapping of electrons injected into a time varying magnetic mirror field from a source located outside the magnetic mirror are reported. The trapping studies are based on the numerical solution of the relativistic equations of motion and extend earlier work carried out in the nonrelativistic limit in static magnetic mirror fields using internal injection. (auth)

4307 MEASUREMENT OF THE ION ENERGY DISTRIBUTION RESULTING FROM THE TURBULENT HEATING OF A PLASMA. Prono, D. S.; Wharton, C. B. (Univ. of California, Livermore). Plasma Phys.; 15: No. 4, 253-267(Apr 1973).

Measurements are reported of the ion energy spectrum of a turbulently heated hydrogen plasma in the Cornell THM-2 experiment. Results show that the ion-heating mechanism simultaneously affects the entire length of the plasma column. Ion heating scales linearly with the current, but the dependence on electric field strength is less than linear. The stored energy which drives the heating pulse is variable from 250 to 1000 J. In all cases the ions account for about 10% of the total plasma energy. The efficiency of energy transfer to the plasma is about 4%, but for the most energetic condition the efficiency is found to be sensitive to the conductivity of the initially cold plasma. (auth)

4308 MAGNETOSONIC PLASMA HEATING IN A TOKAMAK. Vdovin, V. L.; Zinov'ev, O. A.; Ivanov, A. A.; Kozorovitskii, L. L.; Krotov, M. F.; Parail, V. V.; Rakhimbabaev, Ya. R.; Rusanov, V. D.; Shapotkovskii, N. V. JETP Lett. (USSR) (Engl. Transl.); 17: No. 1, 2-4(5 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 1, 4-7(5 Jan 1973).

The plasma was heated with a hf generator (21 MHz) coupled to the plasma by a narrow loop. This loop was introduced into the liner either with or without quartz insulation. The discharge was produced in hydrogen or deuterium at a pressure 8×10^{-5} to 8×10^{-4} torr. The heating effect was determined by measuring the plasma pressure $n(T_e + T_i)$. The diamagnetic signal was determined from the reaction of the current in the circuit of the magnetic-field solenoid. The data are described. (MOW)

4309 HEATING AND CONTAINMENT OF PLASMA IN CROSSED LIGHT BEAMS. Lugovoi, V. N.; Prokhorov, A. M. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 1, 38-40(5 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 1, 52-55(5 Jan 1973).

A method for plasma heating by pulsed laser radiation is described. In this method, the time of plasma heating can be determined by the duration of the laser pulse, and by the same token can be much larger than the corresponding time of the hydrodynamic expansion. In addition, unlike the conditions considered earlier, the area of the skin layer can be much larger than the surface area bounding the entire volume of the heated plasma. (MOW)

4310 HEATING OF ELECTRONS OF A DENSE BEAM PLASMA DISCHARGE IN STRONG MAGNETIC FIELDS. Bredikhin, M. Yu.; Maslov, A. I.; Skibenko, E. I.; Yuferov, V. B. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 2, 315-317(Feb 1973). (In Russian).

The dependence of the electron temperature of a plasma on the intensity of a magnetic field at the center of a coil and its radial profile were determined. A conclusion regarding the heating of electrons on account of cyclotron and hybrid resonances was drawn from a comparison of the results with theory. (tr-auth)

4311 REGULARITY OF PLASMA DIFFUSION IN STELLARATORS. Shpigel, I. S. Tr. Fiz. Inst., Akad, Nauk SSSR; 65: 5-10(1973). (In Russian).

An analysis of a number of published experiments on plasma containment in stellarators was made with reference to the collision mechanism of plasma diffusion in toroidal systems. The results of diffusion calculations showed that, in the cases analyzed, a linear dependence of the plasma containment time on the angle of deflection of the lines of force of the magnetic field was noted. (tr-auth)

4312 INFLUENCE OF THE ELECTRIC FIELD ON THE MOTION OF PARTICLES IN A STELLARATOR. Popryadukhin, A. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 11-25(1973). (In Russian).

Particle motion in the magnetic field of a stellarator was examined in the presence of an electrostatic field, both when equipotential and magnetic surfaces coincided, and also when they did not. In both cases the electric field lead to a regrouping of particles in the region of velocities. For a non-equipotentiality of magnetic surfaces a large deflection of particles is possible, causing an increase in collision diffusion. The diffusion coefficient was evaluted. (tr-auth)

4313 METHODS OF PLASMA INJECTION INTO CLOSED MAGNETIC CONFINEMENT SYSTEMS. Zykov, V. G. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 161-189(1972). (In Russian).

A survey is given of experimental and theoretical research devoted to methods of plasma injection and capture in various types of closed magnetic-confinement systems (stellarator, tokamak, toroidal multipoles, and others). Techniques examined include injection of plasma across the magnetic field, injection with pulsating compensation of the confining magnetic field, injection through a divertor, and injection along a tube of field lines that extend beyond the limits of the magnetic trap. Stability considerations, field configurations, energy losses, contamination risks, and engineering simplicity are evaluated. (IAA)

4314 PLASMA EQUILIBRIUM IN A VINTOTRON. Aleksin, V. F.; Shishkin, A. A. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 141-147(1972). (In Russian).

Theoretical analysis of low-pressure plasma equilibrium in a vintotron (helitron) device which consists of a stellarator-type confinement system where the magnetic configuration is created by a large longitudinal field, a field generated by helical windings, and an axial-current field. A relationship is derived between the displacement of the magnetic axis and the ratio of plasma pressure to the magnetic field pressure (beta parameter). The equilibrium plasma pressure is described as a function of device parameters on the basis of MHD equations. (IAA)

Diagnostics

4315 (CONF-730315-14) LOCAL MEASUREMENTS OF MHD STABILITY PROPERTIES IN THE ST TOKAMAK. Jobes, F. C.; Hosea, J. C. (Princeton Univ., N. J. Plasma Physics Lab.). 1972. Contract AT(11-1)-3073. 4p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A heavy (thallium) ion beam probe diagnostic enables one to scan through the hot tokamak plasma along a "detector line" in a time short relative to the characteristic discharge times. This diagnostic can measure, in principle, the instantaneous local values of electron density, n_e, current density, j_ϕ, and space potential, V_ϕ, as well as perturbations of these quantities. Therefore, it is well suited for the study of the low-frequency oscillatory instabilities found to lead into the deleterious disruptive instability at the low-q and high-density limits to useful tokamak operation. The use and improvements in this technique are discussed. (MOW)

4316 (COO-2233-2) INFRARED EMISSION AND 10.6-μm LASER SCATTERING FROM THE DENSE PLASMA FOCUS. Post, R. S. (Columbia Univ., New York. Plasma Lab.). 1973. Contract AT(11-1)-2233. 83p. Dep. NTIS $6.25.

Thesis.

An experimental study was conducted on a dense plasma focus using CO_2 laser scattering and infrared bremsstrahlung emission along with the standard diagnostics of neutron and hard and soft x-ray emissions and streak and framing photography. These diagnostics help demonstrate a two-stage development of the plasma: a high-density pinch stage followed by a lower-density turbulent stage. Both stages are found to contain local sources of strong nonthermal, infrared emission with enhancements up to 10^6 over thermal bremsstrahlung levels. During the pinch phase, the nonthermal radiation has frequency $\sim 2\omega_p$. During the low-density stage, nonthermal radiation is observed at a frequency many times higher than the average plasma frequency, and it is postulated that small current filaments (plasmoids) form that have density ten times larger than the average plasma density. CO_2 laser backscattering experiments failed to give positive results, thereby indicating turbulent levels of $S(k) \leq 2 \times 10^3$, $k \sim 1\mu^{-1}$, averaged over the scattering volume ($\sim 10^{-1}$ cm^3). However, large $S(k = 1\mu^{-1})$ could occur in local regions characteristic of the IR source dimensions ($\sim 10^{-4}$ cm^3). (auth)

4317 DISTRIBUTION OF FLUX OF CHARGE-EXCHANGE ATOMS FROM A PLASMA OVER THE CROSS SECTION OF THE PLASMA FILAMENT IN THE TOKAMAK-4 APPARATUS. Petrov, M. P. (Ioffe Inst. of Physics and Tech., Leningrad). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 76-79(20 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 2, 110-113(20 Jan 1973).

Ion temperature distribution measurements were made over the cross section of the plasma filament in the Tokamak-4 by tilting the axis of the atom analyzer up and down relative to the equatorial plane of the toroidal chamber. A five-channel atomic-particle analyzer was used and yielded simultaneously the values of the atom flux at five different energies. The distributions obtained in this manner for the flux of deuterium atoms with different energies over the cross section of the plasma filament are shown. (MOW)

4318 SHF METHODS OF MEASURING PLASMA DENSITY AT THE FIAN STELLARATORS. Akulina, D. K.; Nechaev, Yu. I. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 100-133(1973). (In Russian).

A survey is presented of microwave methods of measurement of the plasma density at the FIAN stellarators. A microwave interferometer with an electronic phase rotator is described, which produced 3-cm waves at the base of the lamp. Resonator methods for measuring plasma density are examined, using as a measuring resonator the metal chamber of the stellarator, with the excitation in it of fundamental (λ = 10 cm) and high (λ = 8 mm) frequency oscillations. The range of measurement of the density $n = 10^8$ to 10^{11} cm^{-3}. A Fabry-Perot microwave resonator with λ = 4 mm is described as constructed for densities $n = 10^9$ to 10^{13} cm^{-3}. The effect of the magnetic field of the stellarator on the measurement of the density by resonator methods is discussed. (tr-auth)

4319 ION FLUX PROBE FOR A LOW-PRESSURE DISCHARGE PLASMA. Torven, S.; Babic, M. (Royal Inst. of Tech., Stockholm). J. Phys., E (London); 6: No. 5, 439-442(May 1973).

A new type of ion flux probe for measurements of ion flux as well as total mass flux at the boundary of a stationary low pressure discharge plasma has been constructed and tested. Fine apertures drilled in a thin metal plate inserted in the confining glass wall connect the discharge column with an external volume containing a pressure gauge. Atom and ion fluxes are derived from pressure measurements made at different electric potentials of the metal plate. The results are compared with measurements by Langmuir probe characteristics. (auth)

4320 MICROWAVE DIAGNOSTIC OF A WARM, ANISOTROPIC, INHOMOGENEOUS PLASMA IN A MAGNETIC FIELD. Saison, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Plasma Phys.; 15: No. 4, 325-326(Apr 1973).

An infinitely long cylindrical metallic cavity is considered with a static magnetic field along its axis. The plasma density is explicitly obtained in terms of the density distribution profile, the plasma temperature, the magnetic field intensity and the frequency shift. (UK)

4321 SPECTROSCOPIC METHOD OF MEASURING THE ELECTRON TEMPERATURE AND DENSITY OF A PLASMA FOCUS DISCHARGE. Gratreau, P. (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Plasma Phys.; 15: No. 4, 269-283(Apr 1973). (In French).

An analytic method is developed which provides a simultaneous determination of both electron temperature and density of a dense plasma focus by using time-resolved relative spectroscopic measurements of lines from He-like and H-like ions. The impurity is so chosen that it would not be completely ionized if the equilibrium were reached. The method is based on the precise knowledge of the ionization and recombination coefficients of He-like, H-like, and completely ionized ions; ion losses and neutral injections are accounted for by the theory, and the percentage of impurity is not supposed constant. A numerical example is given for simulation of an experimental result. (UK)

4322 NEW DEVICE FOR CONTINUOUS RECORDING OF THE PLASMA FREQUENCY. Renard, C. (Univ., Bourges, France). ELDO/ESRO Sci. Tech. Rev.; 4: No. 4, 309-312(1972).

A device intended for the continuous and instantaneous measurement of the electron density of the plasma surrounding a probe is described. (FR)

4323 MEASUREMENT OF PLASMA BOUNDARY LAYER BY LANGMUIR PROBE. Akazaki, M.; Fukita, H. (Kyushu Univ., Fukuoka). Kyushu Daigaku Kogaku Shuho; 45: No. 5, 620-625(Oct 1972). (In Japanese).

The apparatus used for this experiment was a spherical discharge tube with 18-cm diameter. A spherical probe (P_s) of 8-mm dia. (2R) was fixed at the center of the tube. A moving probe (P_M) of 2-mm dia. was equipped near the fixed spherical probe. Plasma density and ion density were obtained by Dote's theory and theory by Allen et al., respectively. Spatial distribution of the ion density was measured as a function of the distance (r) between P_M and P_s. Apparent electron temperature and spatial distribution of electron current were observed, and different tendency of these spatial distribution was seen in case of electron sheath and ion sheath. Relation between space potential and r/R, and relation between stray potential and r/R are shown. (Japan)

4324 THEORY OF SPHERICAL LANGMUIR PROBE IN PARTIALLY IONIZED PLASMA WITH UNIFORM MAGNETIC FIELD. Sharma, V.; Verma, J. S. (Birla Inst. of Tech. and Science, Pilani, India). Indian J. Pure Appl. Phys.; 10: No. 10, 721-727(Oct 1972).

A theory to explain the characteristics of a spherical probe in a partially ionized plasma subject to a uniform magnetic field is developed. The problem is approached from the postulates of the kinetic theory and the theory is developed for a small as well as for an arbitrary potential on the probe under symmetric condition. Both curved and straight-line trajectories for particles between collisions have been taken into consideration. The solution obtained in the case of the sheath region indicates that the density and potential distributions are not modified by the magnetic field. The plasma characteristics obtained assuming a curved trajectory for the particles between collisions agree closer with the experimental data as compared to the case of a straight-line trajectory. (auth)

4325 DEVELOPMENT OF A UHF STANDARD OF HIGH PLASMA TEMPERATURES. Kandyba, V. V.; Ioselson, G. L.; Lander, V. A. (State Inst. of Metrology, Kharkov). Metrologia; 9: No. 1, 1-7(1973).

Metrological aspects of the IPTS reproduction in the uhf range for the high and superhigh temperature region as well as the verification scheme are discussed. The latter is designed for graduating radiopyrometers and their antenna systems. A high temperature radiator which can form the basis for a high temperature uhf noise standard with a wide aperture is described. The source random error of the IPTS reproduction delta(random) = 0.21 dB and the unaccountable part of the systematic error delta (systematic) = 0.21 dB. The certification random error with this scheme is delta(cert) = 6%. Methods are discussed for graduating.

radiopyrometers and their antenna systems against the radiator developed with the error of 6 to 10%. (GF)

4326 MEASUREMENT WITH ELECTROSTATIC PROBES IN STELLARATOR L-1. Berezhetskii, M. S.; Grebenshchikov, S. E.; Kossyi, I. A.; Sbitnikova, I. S.; Sphigel, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 82-99(1973). (In Russian).

Techniques are described for measuring the parameters of the plasma which was injected into the stellarator L-1 by a spark source, utilizing electrostatic probes for the measurement. Isolated Langmuir probes, emitter probes, multi-grid electrostatic probes, and double probes were used for measuring plasma potential, electron temperature, ion temperature, ion concentration, fluctuating ion current at the chamber wall, and the quasi-constant ion currents. Probe construction, circuit diagrams, and measurement procedures are discussed as related to stellerator L-1. (tr-auth)

Kinetics (General)

4327 ELECTRON-BEAM EXCITATION OF REGULAR OSCILLATIONS IN AN INHOMOGENEOUS PLASMA WAVEGUIDE. Kalmykova, S. S.; Kurilko, V. I.; Kucherov, V. I.; Tolstoluzhskii, A. P. (Kharkov State Univ.). Zh. Eksp. Teor. Fiz.; 64: No. 2, 471-480(Feb 1973). (In Russian).

The stimulated and self-consistent problems of interaction between a monoenergetic electron beam and plasma waveguide with nonuniform density are considered. The dependence of the amplification factor of a slow charge-density wave on the magnitude and sign of the density gradient and also the efficiency of transformation of the wave into a quasi-transverse wave in the plasma-beam waveguide are determined analytically and numerically. (auth)

4328 ELECTRON TEMPERATURE IN A WEAKLY IONIZED PLASMA IN THE NONLINEAR SKIN EFFECT. Pis'mennyi, V. D.; Rakhimova, T. V.; Rakhimov, A. T. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 64: No. 2, 498-504(Feb 1973). (In Russian).

The nonlinear skin effect of electromagnetic waves in a weakly ionized plasma is considered under conditions of nonlocal coupling between the electron temperature and high frequency electric field strength in the plasma. It is shown that the dependence of the electron temperature in the plasma on intensity of the incident electromagnetic wave may be ambiguous. As a result the electromagnetic wave reflection coefficient for the surface of a weakly ionized plasma may experience an abrupt change when the wave intensity reaches a certain value. (auth)

4329 VOLTAGE–CURRENT CHARACTERISTICS AND POWER RELATION IN ARC PLASMA IN A TRANSVERSE MAGNETIC FIELD. Sen, S. N.; Das, R. P. (North Bengal Univ., Darjeeling, India). Int. J. Electron.; 34: No. 4, 527-536(Apr 1973).

The variation of current and the corresponding voltage across a mercury arc plasma in a varying transverse magnetic field (0 to 3000 G) has been measured for various initial discharge currents. The current gradually decreases and the voltage across the arc increases with the increase of the magnetic field, the power consumed gradually increases and, attaining a maximum value at a certain value of the magnetic field which is different for different initial currents, gradually decreases with the further increase of the magnetic field. Assuming Beckman's expression (Proc. Phys. Soc.; 61: 515(1948)) for the axial field and the electron density distribution in a transverse magnetic field and Langmuir's expression (Phys. Rev.; 26: 585(1925)) for the current in the arc plasma, the observed variation of current and voltage can be satisfactorily explained. A theoretical expression has been derived for the magnetic field at which the power consumed becomes a maximum, by assuming the above deductions and also taking into consideration the variation of electron temperature with magnetic field. The value of the magnetic field thus calculated agrees fairly well with the experimental results, especially for low values of initial currents, and the discrepancy for higher currents has been attributed to the limitations of the above deductions for higher values of H/P. (auth)

4330 COMPLEX EFFECTS OF RADIATION FOR MOVING SOURCES IN PLASMA. Sorokin, Yu. M. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 3, 342-350 (1973). (In Russian).

The angular and frequency spectra of radiation from sources moving uniformly in an isotropic plasma are investigated. The aberration nature of the so-called complex radiation phenomena is clarified. It is shown that the radiation from an isotropic (in the accompanying system K') monochromatic source in a certain frequency band has a limited angular spectrum in the system K connected with the medium whereas for the beam-directed (in K') irradiators with the finite bandwidth the radiation pattern may be considerably broadened for the observer in the system K. The time structure of received signals is considered. It has been discovered that in some cases the radiation from the isotropic (in K') source with continuous radiation from the moment t_0 is received at the fixed point of the system K only during the finite time interval. The possibilities of observing the phenomena are discussed. (auth)

4331 INVESTIGATION OF LOW-FREQUENCY OSCILLATIONS ON THE BASIS OF THE AMPLITUDE MODULATION OF SHF RADIATION FROM A PLASMA. Bakai, A. S.; Ermakov, A. I.; Nazarov, N. I. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 40-47(1972). (In Russian).

It is shown that the emission at the electron plasma frequency which arises during injection of an electron beam into a plasma in which a fast magnetosonic wave is excited takes place as a consequence of nonlinear interaction between a Langmuir wave and the fast magnetosonic wave. Plasma density oscillations produce not only a conversion of Langmuir waves into transverse waves but also cause amplitude modulation of these waves. Observation of the amplitude modulation of plasma emission at the electron plasma frequency makes it possible to determine the spectrum of low-frequency (much lower than the electron plasma frequency) plasma oscillations. The modulation index of the shf radiation can be used to estimate the amplitude of the low-frequency oscillations. (IAA)

4332 INTERACTION OF AN INTENSE ELECTRON BEAM WITH A HOMOGENEOUS AND A NONHOMOGENEOUS PLASMA. Lutsenko, E. I.; Fainberg, Ya. B.; Vasil'chuk, V. A.; Shepelev, N. P. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 5-15 (1972). (In Russian).

Investigation of the problem of obtaining an intense beam of electrons in a plasma (density of 10^{11} to $10^{13}/cm^3$) by using an external electric field to accelerate electrons within the plasma. A 500- to 1000-V/cm field of 0.5-μs duration was created with an inductive accelerator. An electron beam having a current greater than 1000 A and an energy approaching that of the applied voltage was obtained in a plasma layer (less than 2 cm thick) near the cathode. All voltage applied to the plasma becomes redistributed toward this layer. Beam passage through the plasma produces a beam instability which results in a loss of about $\frac{1}{3}$ of the beam current. This instability can be eliminated by using a lengthwise nonhomogeneous plasma. (IAA)

4333 VARIATION OF PLASMA PARAMETERS DURING ACCELERATION IN A STANDING ELECTROMAGNETIC WAVE. Koehne, R. Stuttgart; Univ., Stuttgart (1972). 99p. (In German).

A standing electromagnetic wave is produced (by windings that exert a sinusoidal electron density distribution) and used to accelerate a plasmoid, which in turn is also heated ohmically. The device uses a condenser bank to feed the "sinusoidal" coil. The electron temperature (50,000 K) and electric conductivity (20,000 S/m) has been determined by double and Langmuir probes as well as spectroscopic analysis of emitted radiation using various filters. The velocities measured by optical methods were compared with piezo probe measurements. The maximal electron density is $2 \times 10^{16}/cm^3$. This system is more efficient than configurations with conical coils and may be used in re-entry experiments. (GF)

4334 COOLING OF HEATED REGION FORMED DURING BREAKDOWN OF AIR BY LASER RADIATION. Markelova, L. P.; Nemchinov, I. V.; Shubadeeva, L. P. Zh. Prikl. Mekh. Tekh. Fiz.; No. 2, 54-63(1973). (In Russian).

The problem of the cooling-off of a heated spherical region ("fireball") which is formed during a concentrated laser discharge in air with 5.3 joules of energy was examined. The actual spectral composition of the radiation and its directional pattern was studied. Tables of absorption coefficient were utilized in finding the temperature distribution, fireball density, etc. Pronounced temperature changes were noted; stepped temperatures, connected with a change in the degree of ionization and a corresponding change in the spectral coefficients of absorption of the air. The deexcitation energy and its time dependence were computed. A breakdown phenomenon was produced during strong focusing of the laser radiation in gases, and is discussed. (tr-auth)

Kinetics (Experimental)

4335 EFFECT OF MAGNETIC FIELD ON SOFT X-RAY RADIATION FROM A LASER PLASMA. Volyak, T. B.; Kaitmazov, S. D.; Prokhorov, A. M.; Shklovskii, E. J. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 2, 481-484 (Feb 1973). (In Russian).

It is observed experimentally that in a magnetic field H ~ 200 kOe the total energy of soft x-rays from a laser plasma is reduced on the average by 2.5 times. The explanation of this is that in a magnetic field the plasma shields the target from the laser radiation due to increase of the optical density of the luminous region. The plasma electron temperature is measured and found to be T_e = 200 eV. (auth)

Kinetics (Theoretical)

Refer also to abstract 4294.

4336 (N-72-10700) MONTE CARLO SIMULATION OF NONLINEAR RADIATION-INDUCED PLASMAS. Wang, B. S. H. (Illinois Univ., Urbana. Dept. of Computer Science). May 1972. Contract AT(11-1)-2007. 167p. (NASA-CR-128405; UIUCDCS-R-27-519). NTIS.

Thesis.

A Monte Carlo simulation model for radiation-induced plasmas with nonlinear properties due to recombination was used, employing a piecewise linearized predict-correct iterative technique. Several important variance-reduction techniques were developed and incorporated into the model, including an antithetic variates technique. This approach is especially efficient for plasma systems with inhomogeneous media, multidimensions, and irregular boundaries. The Monte Carlo code developed was applied to the determination of the electron energy distribution function and related parameters for a noble-gas plasma created by alpha-particle irradiation. The characteristics of the radiation-induced plasma involved are given. (auth)

4337 (N-73-11741) STRONGLY MAGNETIZED CLASSICAL PLASMA MODELS. Montgomery, D. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). 1972. 157p. (NASA-CR-129177). NTIS.

The class of plasma processes for which the so-called Vlasov approximation is inadequate is investigated. Results from the equilibrium statistical mechanics of two-dimensional plasmas are derived. These results are independent of the presence of an external dc magnetic field. The nonequilibrium statistical mechanics of the electrostatic guiding-center plasma, a two-dimensional plasma model, is discussed. This model is then generalized to three dimensions. The guiding-center model is relaxed to include finite Larmor radius effects for a two-dimensional plasma. (auth)

4338 ONE EXACT SOLUTION OF THE THEORY OF QUASILINEAR RELAXATION OF A PARAMETRICALLY UNSTABLE PLASMA IN THE FIELD OF POWERFUL RADIATION. Pustovalov, V. V.; Silin, V. P.; Tikhonchuk, V. T. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 2, 84-87(20 Jan 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 2, 120-124(20 Jan 1973).

Results are reported of a quasi-linear theory describing the establishment of a quasi-stationary state in a parametrically unstable plasma exposed to powerful radiation. The obtained self-similar solution of the system of quasi-linear equations makes it possible to determine the spectral density of the field fluctuations in the plasma, the electron distribution function, and the number of fast electrons arising during the course of the quasi-linear relaxation in the development of parametric instability. (MOW)

4339 PRINCIPLES OF PLASMA PHYSICS. Krall, N. A.; Trivelpiece, A. W. International Series in Pure and Applied Physics. New York; McGraw-Hill Book Company (1973). 686p. $25.00

The following chapters are included: (1) thermodynamics and statistical mechanics of equilibrium plasmas, (2) macroscopic properties of plasmas, (3) waves in the fluid plasma, (4) stability of the fluid plasma, (5) transport phenomena in plasma, (6) kinetic equations for a plasma, (7) the Vlasov theory of plasma waves, (8) the Vlasov theory of plasma stability, (9) nonlinear Vlasov theory of plasma instabilities and waves, and (10) fluctuations, correlations, and radiations. (MOW)

4340 QUANTUM CORRECTION FOR ELECTRIC CONDUCTIVITY OF COULOMB PLASMA. Istomin, V. V.; Dovgopol, S. P. (Ural Polytechnic Inst., Sverdlovsk, USSR). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 507-508(Mar 1973). (In Russian).

The Fokker-Planck equation, adjusted for a first quantum correction in the interval of collisions, proportional to the square of Planck's constant, was used in a determination of the electric conductivity of Coulomb plasma in a weak homogeneous and constant electric field. The quantum correction to the electric conductivity was inversely proportional to the Coulomb logarithm and decreased the plasma conductivity. (tr-auth)

4341 DETECTION OF FEEDBACK IN PLASMA-ELECTRON BEAM SYSTEMS. Kovalenko, V. P. (Inst. of Physics, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 514-515(Mar 1973). (In Russian).

It was experimentally observed that a longitudinal uhf electric field existed at a sufficient density of an electron beam in interaction with a plasma. The amplitude of the uhf field raised the noise level significantly. This field arose as a consequence of feedback from a zone of nonlinear oscillations excited by the beam in the plasma. Feedback led inevitably to beam modulation, and consequently was considered as one of the basic factors which caused excitation of a narrow packet of waves during a plasma-beam interaction. (tr-auth)

4342 MATHEMATICAL PROBLEMS OF STOCHASTIC PROCESSES IN A PLASMA. Polovin, R. V.; Rozhkov, V. V. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 67-69(1972). (In Russian).

Stochastic processes in a plasma are described by partial differential equations with random coefficients or random boundary conditions. Probabilistic properties of the solutions can be determined by existing methods in the case of nonrandom characteristics of these equations. However, the formulation of the problem itself becomes ambiguous in the case of random characteristics, and it is shown that these equations should be replaced by deterministic equations for the distribution function. The latter are shown to belong to a parabolic type of equations. (IAA)

4343 STABILITY ANALYSIS OF LOW-PRESSURE AXISYMMETRIC TOROIDAL PLASMA SIMULATIONS. Grimm, R. C. (Culham Lab., Abingdon, Eng.); Johnson, J. L. J. Comput. Phys.; 11: No. 4, 591-605(Apr 1973).

A study of the local stability of a numerical algorithm for simulating two-dimensional small inverse-aspect-ratio plasma confinement leads to an amplification matrix closely related to the dispersion relation given by an analytic treatment. Both leapfrog and Lax-Wendroff schemes are carried through; the latter provides results in good agreement with the physics. (auth)

4344 COMPARISON OF FOURIER-HERMITE AND POWER TRANSFORM SOLUTIONS OF THE NONLINEAR VLASOV EQUATION. Emery, M. H.; Joyce, G. (Univ. of Iowa, Iowa City). J. Comput. Phys.; 11: No. 4, 493-506(Apr 1973).

The power transform method of integrating the nonlinear Vlasov equation is applied to two physically significant problems and the solutions are compared with the results of the Fourier-Hermite method. The problems considered are one-dimensional, with periodic boundary conditions and involve (1) Landau damping in a Maxwellian plasma, and (2) the two-beam instability with equal electron beams. The power transform method is discussed and several truncation techniques are presented. It is found that an extrapolation procedure can be used which allows a truncation of the infinite matrix without causing numerical instabilities in the nonlinear system. Close quantitative agreement between the results of the two methods is found. (auth)

Production

Refer also to abstract 4336.

4345 NUMERICAL MODELING OF LASER-PRODUCED PLASMAS: THE DYNAMICS AND NEUTRON PRODUCTION IN DENSE SPHERICALLY SYMMETRIC PLASMAS. Goldman, E. B. (Univ. of Rochester, NY). Plasma Phys.; 15: No. 4, 289-310 (Apr 1973).

A series of numerical experiments were conducted to investigate the dynamics and neutron production in laser-irradiated, dense spherically symmetric plasma. The results lead to the development of scalings for energy absorption, shock strength and optimum neutron production for subnanosecond, high-energy pulses. (auth)

4346 INVESTIGATION INTO THE MECHANISMS OCCURRING IN THE DISCHARGE OF AN ION SOURCE. Jacobsen, R. A.; Eubank, H. P. (Princeton Univ., NJ). Plasma Phys.; 15: No. 4, 243-252(Apr 1973).

An experimental study of the mechanisms occurring in the constricted type of discharge used in ion sources was performed. The variations on the radius of the fireball forming at the constriction, together with the plasma potential, electron temperature, and density variation through the discharge, were measured as a function of the discharge current and neutral gas flow rate and pressure. The studies showed that the fireball grows out of the background plasma whenever local conditions require that the electron drift velocity exceed the ion sound speed. (auth)

4347 PARAMETRIC BACKSCATTERING OF A LINEAR ELECTROMAGNETIC WAVE IN A PLASMA. Galeev, A. A.; Laval, G.; O'Neil, T. M.; Rosenbluth, M. N.; Sagdeev, R. Z. (Inst. of High Temperatures, Moscow). JETP Lett. (USSR) (Engl. Transl.); 17: No. 1, 35-38(Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 1, 48-52(5 Jan 1973).

Possible mechanisms of energy absorption from a powerful laser beam by the plasma corona of a contracting deuterium drop are connected with parametric instabilities. Two parametric processes lead to the conversion of the energy of the incident electromagnetic wave into the energy of plasma oscillations, namely the "decay instabilities"—the pump wave (photon) "plasmon" + "phonon" (ion sound) and the pump wave "plasmon" + "plasmon." These instabilities are discussed. (MOW)

4348 PLASMA PRODUCTION APPARATUS HAVING DROPLET PRODUCTION MEANS AND LASER PRE-PULSE MEANS. Lubin, M. J. (to United States Atomic Energy Commission). U. S. Patent 3,723,246. 27 Mar 1973. Filed date 27 May 1971. 10p.

The apparatus and method for producing a freely expanding high-temperature plasma from a high-density target that is irradiated with laser light by a tailored laser pulse are described. Means are described for producing a tailored laser light pulse and a tailored target for producing a laser–target interaction. Laser–target micro-explosions are also contemplated. (Official Gazette)

4349 EVIDENCE OF STIMULATED BACKSCATTERING OF LASER RADIATION FROM A LASER-PRODUCED PLASMA. Eidmann, K.; Sigel, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1972). vp.

From international conference on the interaction of laser with matter; Marly le Roi, France (9 Oct 1972).

The reflection of laser light from a laser-produced deuterium plasma was experimentally investigated. Strong evidence of stimulated backscattering was obtained. (GF)

4350 INVESTIGATION OF A DENSE PLASMA PRODUCED BY AN ELECTRON BEAM IN A MAGNETIC MIRROR. Bredikhin, M. Yu.; Il'chenko, A. M.; Maslov, A. I.; Skibenko, A. I.; Skibenko, E. I.; Yuferov, V. E. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 147-161(1972). (In Russian).

The production of high-density plasma (10^{14} to 10^{15} particles/cm^2) by utilizing the interaction between a beam of high-energy electrons and neutral gas in a magnetic-mirror system is reported. Neutral gas was introduced into the interaction region in the form of a supersonic jet, which made it possible to create the required pressure gradient without employing a specialized differential pumping system. Conditions governing the exponential growth in plasma density are defined on the basis of the beam–plasma discharge parameters. Results indicate that a plasma density of 5 to 7×10^{14} particles/cm^3 can be obtained by interaction of an electron beam with a supersonic jet of neutral gas. (IAA)

4351 LASER ENERGIZED PLASMA SOURCE. Ehlers, K. W.; Brown, I. G.; Lietzke, A. F. (to United States Atomic Energy Commission). U. S. Patent 3,723,703. 27 Mar 1973. Filed date 8 Feb 1971. 6p.

An apparatus is described for creating and heating a plasma within a magnetic field. A solid pellet of material from which the plasma is to be made, such as a frozen pellet of hydrogen, is dropped into a magnetic containment field. A high-power laser directed through the field is activated to highly energize the hydrogen. The laser beam is concentrated at a focal point so that maximum energy is transferred to the pellet. The pellet falls within a steady-state laser beam directed vertically through the focal point. The laser is pumped and fired when the pellet is in the focal point by signals from photomultipliers that detect the presence of a pellet just above the focal point. (Official Gazette)

Stability

4352 (N–73-12778) LOW-FREQUENCY MACROSCOPIC INSTABILITIES OF FULLY IONIZED MAGNETOPLASMA. Rognlien, T. D. (Stanford Univ., Calif. Inst. for Plasma Research). Oct 1972. 100p. (NASA-CR-129517; SUIPR–487). NTIS.

Studies are described of low-frequency quasi-static instabilities in a fully ionized plasma. The plasma is assumed to be immersed in a uniform magnetic field, and is either uniform or has a number density gradient perpendicular to the magnetic field. A moment-equation description of the ion and electron dynamics is used; collisions are assumed to have a strong effect on electron motion along the magnetic field. Before considering specific modes, a stability analysis is developed that allows a classification of wave growth characteristics to be made for a bounded system from solutions to the dispersion relation for an infinite system. Also, a method is given for calculating the normal mode frequencies and wave profiles by using the reflection coefficients at the boundaries. For wave propagation perpendicular to the magnetic field, the flute wave is studied in cylindrical geometry. The destabilizing effect of a radial electric field is considered by solving a differential equation. (auth)

4353 ION CYCLOTRON DRIFT LOSS-CONE INSTABILITY WITH A COEXISTING COLD PLASMA. Nambu, M.; Nambu, N. (Kyorin Univ., Tokyo). Plasma Phys.; 15: No. 4, 285-288(Apr 1973).

The stability condition of an ion cyclotron drift loss-cone wave (nonflute mode) in a nonuniform plasma with a coexisting cold plasma is considered. It is shown that the presence of low-energy components in the plasma may significantly affect the stability criteria of these ion cyclotron waves. Furthermore, perturbations at frequencies that are multiples of the ion cyclotron frequency may be destabilized when the number density of high-energy protons exceeds the critical value that is determined by the number density of cold plasma and the strength of field inhomogeneity. (auth)

4354 NONLINEAR TRANSFORMATION AND STABILIZATION OF BEAM–PLASMA INSTABILITY. Demchenko, V. V.; El-Siragy, N. M. (Atomic Energy Establishment, Inshas, Egypt). PLPHB; 15: No. 4, 322-325(Apr 1973).

It is suggested that the allowance for strictional nonlinearity changes fundamentally the beam–plasma interaction thereby reducing the growth rate and sometimes even disrupting the instability. (auth)

4355 THEORY OF LOCAL HYDROMAGNETIC STABILITY OF TOROIDAL PLASMA CONFIGURATIONS. Mikhailovskii, A. B. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 2, 536-547(Feb 1973). (In Russian).

It is pointed out that, despite abundance of investigations of hydromagnetic stability of toroidal plasma configurations, the problem still remains unsolved. In particular, the meaning of the general geometric Mercier criterion, which plays an important role in modern calculations of stability of concrete systems, remains nuclear. A general theory of local instability is developed in the present paper from which it follows that the Mercier criterion is a necessary and sufficient condition for plasma stability with respect to a particular class of local perturbations, such as that for which the radial wavelength is small with respect to the wavelength along the small azimuth. Stability of a plasma confined by Shafranov-type configurations is also investigated with respect to local perturbations not described by the general geometric Mercier criterion. It is shown that the necessary and sufficient condition for local stability of such configurations is equivalent to the Mercier criterion simplified for the case of these configurations. (auth)

4356 NONLINEAR THEORY OF PARAMETRIC INSTABILITY OF WAVES IN A PLASMA. L'vov, V. S.; Rubenchik, A. M. (Novosibirsk State Univ., USSR). Zh. Eksp. Teor. Fiz.; 64: No. 2, 515-525(Feb 1973). (In Russian).

The nonlinear stage of instability of an external high-frequency electric field $E(t) = E_0 \cos \omega_0 t$ decaying into a Langmuir (LW) and ion-sound (ISW) wave $\omega_0 = \omega_k + \Omega_{-k}$ is studied. It is shown that correlation of the LW and ISW phases in the ω_k, Ω_{-k} pair which appears at the linear stage of instability determines the nonlinear behavior of the wave system. Hence the kinetic equation for waves is principally inapplicable in this problem. Equations are formulated in which the statistical problem of interaction between parametrically excited waves is reduced to the dynamic problem of pair interaction. From the linear dynamic equations for decay instability they differ only by self-consistent renormalization of the wave spectrum and nature of their interaction with an external field. The qualitative pattern of nonlinear behavior of waves considerably depends on the frequency and amplitude of the external field. The amplitudes of parametrically excited waves, their distribution in k-space and the energy flux into the plasma are all estimated. (auth)

4357 CORRELATION OF PLASMA POTENTIAL AND DENSITY OSCILLATIONS AND CONVECTIVE TRANSPORT OF PARTICLES ACROSS MAGNETIC FIELD IN PENNING DISCHARGE UNDER ROTATIONAL INSTABILITY. Romanyuk, L. I.; Slobodyan, V. M. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 456-462(Mar 1973). (In Russian).

Correlation of the amplitude, frequency, and phase characteristics of the density and potential oscillations resulting from the rotational instability of a hot-cathode Penning discharge plasma was studied. An attempt was made to explain qualitatively the oscillation amplitude-frequency characteristics of nonlinear effects. The data are obtained on the plasma density and potential perturbation for the oscillations with azimuthal mode m = 1, 2, 3. The structure of the perturbation is established to give rise to a convective flow of particles across the magnetic field. The magnitude of the convective flow is estimated. This flow is

shown to form a significant part of the total flow and to determine in essence an increase in the particle escape across the magnetic field observed under development of rotational instability. (auth)

4358 QUASI-LINEAR EFFECTS IN FLOW INSTABILITIES. Vedenov, A. A.; Ryutov, D. D. Vop. Teor. Plazmy; No. 6, 3-69 (1972). (In Russian).

The main methods and results of solution of the quasi-linear equations for flow instabilities are presented. The relaxation of a nonrelativistic electron beam is considered for the one-dimensional case with and without boundary conditions, as well as the three-dimensional case with initial conditions, and the effect of a plasma inhomogeneity on the propagation of a Langmuir oscillation is evaluated. The relaxation of an ultrarelativistic electron beam in both homogeneous and inhomogeneous plasmas is then considered, and a detailed investigation is made of the anomalous resistance of a collisionless plasma, dwelling, in particular, on the resistance during the initial stage of the current, on asymptotic solution of the problem of anomalous resistance using self-similar variables. In addition, a study is made of the self-similar equations for both one- and three-dimensional models, and the problem of the anomalous resistance to a current perpendicular to the magnetic field is discussed. Finally, quasi-linear effects arising during the expansion of electron and ion clusters are considered, leading to the derivation and solution of quasi-gasdynamic equations. (IAA)

4359 ELECTROMAGNETIC INSTABILITIES OF A NON-MAXWELLIAN PLASMA. Mikhailovskii, A. B. Vop. Teor. Plazmy; No. 6, 70-138(1972). (In Russian).

The theory of electromagnetic instabilities of a plasma with a non-Maxwellian particle velocity distribution is reviewed. Instability of a high-pressure plasma with an anisotropic electron distribution is studied, buildup of oscillations of a cold plasma by a group of fast electrons with an anisotropic velocity distribution is considered, and electromagnetic instabilities of a plasma permeated by an electron beam with an anisotropic velocity distribution are investigated. Some additional classes of instabilities arising in a plasma with non-Maxwellian electrons in the case of a finite relativistic parameter are discussed. The theory of ion instabilities is reviewed, starting from an analysis of an anisotropic high-pressure plasma. Instabilities characteristic of colliding plasmas and plasma jets with an inhomogeneous velocity profile are discussed, as well as conical instabilities of a spatially homogeneous plasma with finite beta. (IAA)

4360 THEORY OF PARAMETRIC INSTABILITIES AND HARMONIC GENERATION IN TONKS-DATTNER RESONANCES. Wolschke, S. Beitr. Plasmaphys.; 12: No. 5, 273-277(1972).

One-dimensional fluid theory of Tonks-Dattner resonances in inhomogeneous, bounded plasmas is extended to stronger exciting electric fields. The relation of parametric instabilities and harmonic generation with Tonks-Dattner resonances are worked out in a more direct way than in previous work. Electric field thresholds and growth rates for parametric instabilities are obtained from the theory of the homogeneous Mathieu equation. Stationary excitation at the driving frequency and its harmonics follows from a particular solution of an inhomogeneous Mathieu equation. (auth)

4361 HYDROMAGNETIC STABILITY OF CLOSED PLASMA CONFIGURATIONS. Solov'ev, L. S. Vop. Teor. Plazmy; No. 6, 210-290(1972). (In Russian).

The theory of hydromagnetic stability of plasma is considered within the framework of magnetohydrodynamics, assuming ideal conductivity and the absence of viscosity. Various coordinate systems which may be used to determine the embedded toroidal magnetic surfaces constituting the closed plasma configurations are described. A study is made of various equilibrium axisymmetric plasma configurations, the equilibrium of arbitrary plasma configurations is considered, and the integral characteristics of equilibrium toroidal configurations are investigated. Methods of studying the stability of a plasma cylinder by the method of small oscillations or by employing the energy principle are reviewed. The stabilizing action of conducting end faces is considered, and general geometrical stability criteria are developed for closed and quasi-periodic configurations. (IAA)

Thermonuclear Engineering and Equipment

4362 (CONF-730315-12) INTERPRETATION OF MAGNETIC DISTURBANCES OBSERVED IN TOKAMAKS. Rutherford, P. H. (Princeton Univ., N. J. Plasma Physics Lab.). [nd]. Contract AT(11-1)-3073. 4p. Dep. NTIS $3.00.

From third international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

In the constant current phase of tokamaks, small-amplitude, slow growing, kink-like m = 2 to 4 magnetic perturbations are observed, followed by more violent "disruptive" instabilities that are accompanied by inward shifts in major radius and negative-voltage spikes. An interpretation of the m = 2 to 4 perturbations as resistive tearing modes is supported by linear stability criteria evaluated for the equilibrium current profiles typical of present tokamaks. In this paper it is shown that the mode amplitudes and their long-time integrity may be explained by nonlinear restraints on tearing-mode growth: nonlinear eddy currents arise near the singular surface, producing $\vec{j} \times \vec{B}$ forces that replace the inertia in opposing the vortex-flow associated with the tearing mode. (auth)

4363 (LA-5145-MS) LASER CTR SYSTEMS STUDIES. Williams, J. M. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $3.00.

LASL Laser-initiated Controlled Thermonuclear Reactor (LCTR) engineering systems studies are described. Design considerations are discussed in the following generalized areas of laser-driven fusion reactor design: (1) beam transport; (2) pellet fabrication and delivery; (3) beam/pellet coupling; (4) energy collection and conversion; and (5) containment and shielding. The lithium wetted-wall, laser-driven fusion reactor concept studied at LASL is described and major design features are reviewed. Plans for study of other conceptual laser CTR systems are briefly summarized. (auth)

4364 (LA-5178-MS) RADIAL COLLAPSE OF A DENSE PLASMA SPINDLE FOCUS. Ware, K. D.; Mather, J. W. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

A new approach to dense plasma focus comprising two high-pressure z-pinch current sheaths collapsing to an axially symmetric spindle-shaped plasma is described. The spindle focus appears to provide greater axial plasma confinement than the open-ended, coaxial, dense plasma focus. A high-pressure z-pinch in the proper geometry, with large diameter and small axial length, was studied to determine whether the current-shock sheath would move off the insulator and collapse radially to a high-density pinch a few millimeters in diameter. The discharge was operated in a static fill pressure of argon from 0.1 to 1.0 torr and/or deuterium up to 10 torr. The current-shock sheath moved off the insulator and collapsed symmetrically to the axis at velocities $>5 \times 10^6$ cm/sec. Soft x rays were observed for about 100 nsec, and there was some evidence of neutron production above the 10^8-counts/discharge detector threshold. The discharge appears to be a plasma of $>10^{19}$/cm^3 density with low-temperature ions and electrons. Experiments with the complete spindle-focus geometry should be attempted to determine whether a longer lived dense plasma can be produced. This plasma seems an ideal levitated plasma for heating experiments with high-energy relativistic electron or laser beams. (auth)

4365 (ORNL-TM-3096) CONCEPTUAL DESIGN OF THE BLANKET AND SHIELD REGION AND RELATED SYSTEMS FOR A FULL-SCALE TOROIDAL FUSION REACTOR. Fraas, A. P. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 86p. Dep. NTIS $6.50.

An effort was made to delineate the many boundary conditions that must be met in the design of a full-scale toroidal fusion reactor power plant with particular emphasis on the special problems associated with the blanket and magnet shield region. These have included provisions for cooling, fuel injection, spent plasma scavenging, MHD pumping power and heat transfer problems, reactor safety considerations, materials compatibility, fabrication, assembly, maintenance, and costs. In short, an effort was made to take into account all of the boundary conditions that could be envisioned and evolve a well-balanced design with reasonable compromises throughout. (auth)

4366 (ORNL-TM-4156) FUSION TECHNOLOGY STUDIES PROGRESS REPORT FOR PERIOD ENDING DECEMBER 31, 1972. McHargue, C. J. (Comp.). (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 110p. Dep. NTIS $7.50.

Prior to 1972 there was a relatively small effort in the Metals and Ceramics Division that supported studies of the Thermonuclear Division. In early 1972, this work was markedly increased as a portion of the Fusion Reactor Technology Program. Studies on several facets of radiation damage and the compatibility of lithium with refractory metal alloys are described in this report. A separate abstract was prepared for each of nine sections. (MOW)

For abstracts of individual sections see: 3193, 3285-3291, and 4367.

4367 (ORNL-TM-4156, pp 86-98) EXAMINATION OF THE FORCED-CIRCULATION LITHIUM LOOP. DeVan, J. H.; Fleischer, B.; Klueh, R. L.; Long, E. L. Jr. May 1973.

In fusion technology studies progress report for period ending December 31, 1972.

Results after 3000-h operation of the loop fabricated from tantalum-base alloy T-111 are presented. Results are compared with those from an earlier loop of tantalum-alloy T-222 and Nb-1Zr operated with lithium. Knowledge of the velocity effect with T-111 will allow realistic formulation of test requirements for future compatibility studies of niobium alloys. (MOW)

4368 (UCRL-51351) CRITERIA FOR DESIGN OF AN ADIABATIC EXPANDER FOR A DIRECT ENERGY CONVERTER. Moir, R. W.; Lee, J. D. (California Univ., Livermore. Lawrence Livermore Lab.). 15 Feb 1973. Contract W-7405-eng-48. 20p. Dep. NTIS $4.00.

Proper design of a plasma expander will permit it both to guide the plasma and to convert to directed motion the random motions of the particles. One design criterion was found to be adiabaticity, i.e., that the normalized magnetic moment, $\mu = \frac{1}{2} mv_\perp^2/\frac{1}{2} mv^2B$ be invariant. This condition is met when the variation in field strength along the field lines is $|pdB/Bds| \leq \epsilon_{||}$, where p is the particle pitch length ($p = v_{||} 2\pi/\omega_c$; $\omega_c = eB/m$) and where $\epsilon_{||}$ must be 3 or less. Another criterion, stating that the field line curvature r must be sufficiently gentle for the particles to follow the field line, is $\rho/r = (pdB/Bds_\perp) \leq \epsilon_\perp$, where $\epsilon_\perp$ must be about 0.2. These adiabatic criteria are easily satisfied. For one reactor example the length was only 12 m. The necessary 1.4-m adiabatically limited straight section is easily accommodated in the 2.9-m overall length of the experimental direct energy converter being built in this laboratory. (auth)

4369 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 3, 1973. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 66p.

This listing contains 338 references on various aspects of plasma physics and fusion reactor research. (MOW)

4370 NEUTRON EMISSION OBSERVED DURING THE ELECTRICAL EXPLOSION OF DEUTERATED LIQUIDS OF METALLIC CONDUCTIVITY. Fischer, U.; Jaeger, H.; Lochte-Holtgreven, W. (Univ., Kiel). Phys. Lett., B; 44B: No. 2, 161-162(16 Apr 1973).

Impulse heating of Li/ND_3 solutions of metallic conductivity in a capacitor discharge circuit produces short-time neutron pulses of 10 to 50 ns duration right at the beginning of the discharge. The emission per pulse is variable but amounts up to more than 10^7 neutrons, originating from the $D(d,n)^3He$ reaction. The pulses appear with capacitor charge potentials above and even shortly below 100 kV and at pressures which allow only very small mean free path lengths of the plasma particles. (auth)

4371 HIGH-CURRENT PLASMA ELECTRON GUN WITH 50 kA PULSE CURRENT. Iremashvili, D. V.; Kuril'nikov, S. V.; Leont'ev, N. I.; Osepashvili, T. A. JETP Lett. (USSR) (Engl. Transl.); 17: No. 1, 7-8(5 Jan 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 17: No. 1, 11-13(5 Jan 1973).

A high-current plasma electron gun containing a cathode based on spark sources and an anode with a hole is described. It differs from earlier ones in that the coefficient of current transmission and the stability of the kiloampere electron beam are increased by filling the anode hole with a plasma generated by a group of spark sources disposed on the anode electrode uniformily and normally to the walls of the hole. A schematic diagram of the gun and a simplified block diagram of its power supply are shown. (MOW)

4372 CENTRAL STATION POWER GENERATION BY LASER-DRIVEN FUSION. Booth, L. A. (Los Alamos Scientific Lab., NM). Nucl. Eng. Des.; 24: No. 3, 263-313(1973).

The feasibility of using laser-driven fusion pulses for the commercial generation of electric power was investigated. The present paper discusses the general aspects of electric power plants based on laser-driven fusion energy sources, outlines the considerations that led to the wetted-wall concept on which the present study is based, presents detailed results of calculations that indicate the feasibility of the concept, discusses aspects of important areas that are not well defined, summarizes related needs for further study, and compares the concept with plants based on magnetically confined controlled thermonuclear reactions. (auth)

4373 MEASUREMENTS REFERRING TO PLASMA FOCUS SCALING LAWS. Rapp, H. (Univ., Stuttgart). Phys. Lett.; 43A: No. 5, 420-422(9 Apr 1973).

In order to establish scaling laws and characteristic curves of a plasma focus device, the neutron output was measured as a function of the deuterium filling pressure, accelerator length, and capacitor energy. (auth)

4374 RESEARCH: A NEW SYSTEM FOR CONTROLLED NUCLEAR FUSION. Nowak, K. Nucleus (Bonn); 18: No. 46-50, 406-408(1972). (In German).

A plasma beam is formed by joining accelerated atomic and electron beams which in turn has a high density and only axial-velocity components. These plasma beams colliding in a reaction zone that has a length of a few meters (to allow all atomic ions to fuse if the density is assumed to be about 10^{24} ions/cm^3). The limited length of the reaction zone reduces the reaction time to practically zero in contrast to thermonuclear plasmas—and operation with short pulses is suitable. The plasma beam is guided by the strongest field lines of the contracting field and forms a hollow cylinder configuration, which results finally in a helical intertwining of particle trajectories. (GF)

4375 EFFECT OF GEOMETRIC ERROR OF THE MAGNETIC SYSTEM ON THE FIELD TOPOLOGY OF A STELLARATOR. Danilkin, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 26-49(1973). (In Russian).

The influence of perturbations in the geometric parameters of a stellarator's magnetic system on its field topology is discussed. Large and dangerous possible geometric distortions are examined, and essential tolerances are evaluated. For fundamental resonance in the near-axis region, caused by relative skewness in the longitudinal and helical fields of the order of 10^{-3}, a displacement in the magnetic axes of the system may achieve a magnitude commensurate with the transverse aperture of the magnetic field. This demands a careful alignment of the magnetic system or the design of special system for compensating for the action of the perturbations. (tr-auth)

4376 NEW DESIGN FOR A TWO-TURN STELLARATOR. Danilkin, I. S.; Shpigel, I. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 50-64(1973). (In Russian).

Specifications for a toroidal system were formulated for the basis for a two-turn stellarator, and differed from previous large stable field configurations as possessing improved characteristics which assured plasma containment. The design offered ready access to the operating space, good vacuum conditions, and had small mechanical loading on the most intricate technological elements. (tr-auth)

4377 STELLARATOR TOR-2. Ivanovskii, M. A.; Popov, S. N.; Popryadukhin, A. P. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 65-72(1973). (In Russian).

The stellarator Tor-2 differs from other stellarators in having a magnetic field produced not by helical windings but by discrete coils with an elliptical profile. Theoretical premises are proposed that may serve as the basis for a design of such a device. (tr-auth)

4378 STRUCTURE OF THE MAGNETIC FIELD OF STELLARATORS TOR-1 AND TOR-2. Andryukhina, E. D.; Ivanovskii, M. A.; Popov, S. N.; Popryadukhin, A. P.; Fedyanin, O. I.; Khol'nov, Yu. V. Tr. Fiz. Inst., Akad. Nauk SSSR; 65: 73-81(1973). (In Russian).

The structure of the magnetic surfaces in the toroidal plasma traps with a two-turn helical field was investigated with an electron beam in the case of stellarators TOR-1 and TOR-2. An ordinary probing method was used for recording the beam, in connection with a dielectric grid. The structure of the surfaces was shown to be regular up to the angles of rotary transformation i of the order of 5.5 π in all ranges of change in i, with the exception of resonance values of $i = \pi, 2\pi, 4\pi$, for which splitting of the surfaces was registered with the formation of a rosette structure. The amplitude of the resonance excitations, as measured by the width of the rosettes, had an order of magnitude 10^{-4} from the amplitude of the fundamental field of the stellarator. (tr-auth)

4379 DEVELOPMENT AND CONSTRUCTION OF THE MAGNETIC SYSTEM FOR THE URAGAN STELLARATOR AND INVESTIGATION OF MAGNETIC SURFACES WITH A LARGE SHEAR. Aleksin, V. F.; Biryukov, O. V.; Vishnevetskii, V. N.; Georgievskii, A. V.; Grot, Iu. I.; Dikii, A. G.; Ziser, V. E.; Kitaevskii, L. Kh.; Konotop, P. I.; Pogozhev, D. P. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 73-112(1972). (In Russian).

The Uragan stellarator was designed in a racetrack configuration to facilitate the use of different methods for plasma diagnostics and heating. The device employs a triple helical field with a large field-line crossing parameter (shear). Experimental studies of the magnetic surfaces were performed with the aid of low-energy electron beams, and the results demonstrate the existence of closed magnetic surfaces with large shear (about 0.09) and rotational angle (about 240°) values. Magnetic system design aspects, which resulted in the large shear values, are described along with magnetic alignment procedures. (IAA)

Wave Phenomena

4380 (N-73-12777) LAGRANGIAN METHODS IN THE ANALYSIS OF NONLINEAR WAVE INTERACTIONS IN PLASMA. Galloway, J. J. (Stanford Univ., Calif. Inst. for Plasma Research). Oct 1972. 172p. (NASA-CR-129597; SU-IPR-488). NTIS.

An averaged-Lagrangian method is developed for obtaining the equations which describe the nonlinear interactions of the wave (oscillatory) and background (nonoscillatory) components which comprise a continuous medium. The method applies to monochromatic waves in any continuous medium that can be described by a Lagrangian density, but is demonstrated in the context of plasma physics. The theory is presented in a more general and unified form by way of a new averaged-Lagrangian formalism which simplifies the perturbation ordering procedure. Earlier theory is extended to deal with a medium distributed in velocity space and to account for the interaction of the background with the waves. The analytic steps are systematized, so as to maximize calculational efficiency. An assessment of the applicability and limitations of the method shows that it has some definite advantages over other approaches in efficiency and versatility. (auth)

4381 (ORO-4338-2) LINEAR ION ACOUSTIC WAVES IN A DENSITY GRADIENT. Jones, D. (University of South Florida, Tampa (USA). Dept. of Physics). 15 Apr 1973. Contract AT(40-1)-4338. 28p. Dep. NTIS $3.50.

The experimental and theoretical behavior of linear ion acoustic waves in density gradients formed in a collisionless discharge plasma was studied. Both the experiment and theory show a strong spatial growth of the density perturbation n_1 produced by the wave when the wave propagates in the direction of increasing density and a damping when the wave propagates in the direction of decreasing density. Theoretically, the growth and damping rates are found to be proportional to $\sqrt{n_0}$, where n_0 is the local unperturbed density. Using the measured density profile, one finds good agreement between experiment and linearized fluid theory. Although the wave amplitude n_1, itself, decreases as the wave propagates into a region of lower density, the relative amplitude n_1/n_0 increases. This can be expected to lead to wave steepening and shock-like behavior, as noted previously by others. (auth)

4382 NONLINEAR ION SOUND WAVES IN A PLASMA WITH THREE-DIMENSIONAL RANDOM INHOMOGENEITIES. Tamoikin, V. V.; Fainshtein, S. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 2, 505-509(Feb 1973). (In Russian).

The problem of nonlinear ion sound waves in a nonisothermal plasma containing weak three-dimensional random electron concentration inhomogeneities is considered. The fundamental integro-differential equation for nonstationary wave processes in a weakly nonlinear and randomly inhomogeneous plasma is derived. It is shown that under certain conditions it may be reduced to the modified Burghers and Kortweg-de Vries-Burghers equations. Stationary waves are investigated. An analysis reveals that random inhomogeneities of the equilibrium concentration lead to oscillations behind the shock wave front. Moreover, in some cases a weak ion sound shock wave may appear. (auth)

4383 SURFACE ADSORPTION COEFFICIENT OF EXTRAORDINARY WAVE WITH SPECULAR REFLECTION OF PARTICLES FROM PLASMA BOUNDARY. Kondratenko, A. N. (Physical-Technical Inst., Karkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 10, 1585-1589(Oct 1972). (In Russian).

Incidence of an electromagnetic wave on the boundary of a magneto-active plasma is considered for the case when the electric vector being perpendicular to a dc magnetic field. It is shown that the surface adsorption coefficient is proportional to v_e/c under specular reflection of plasma particles from the boundary and does not depend on the plasma density if the wave frequency is of the order of the electron cyclotron frequency. (auth)

4384 TEMPORAL PHASE MIXTURE ECHOES. Bachmann, P.; Sauer, K.; Wallis, G. (Zentralinstitut fuer Elektronenphysik, Berlin). Fortschr. Phys.; 20: No. 3, 147-199(1972). (In German).

The study shows that the nonlinear response to short-term external disturbances as well as the fading through inhomogeneous relaxation are essential, general characteristics of all echo types. The time course of echoes is discussed first. Then the most important types of echoes are described, including their production and detection. By means of geometrical models, the existence of several basic types of echoes is explained. These types are subjected to a comprehensive theoretical analysis. The treatment subsequently is extended to cyclotron and plasma echoes. (HBG)

4385 RADIAL STRUCTURE OF OSCILLATIONS OF PLASMA COLUMN IN CROSSED FIELD AT ADVANCED RESONANT CYCLOTRON INSTABILITY. Farenik, V. I.; Vlasov, V. V.; Rozhkov, A. M.; Stepanov, K. N.; Suprunenko, V. A.; Yakimchuk, Yu. V. (Kharkov State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 3, 394-396(Mar 1973). (In Russian).

Experimental results of investigations of resonant cyclotron instability of rotating plasma in a homogeneous magnetic field are presented. A series of spatial-separated cyclotron oscillations with frequencies $\omega = n\omega_{Hi}$ (n = 1, 2, 3) is shown to develop in plasma with a corresponding selection of values for radial electric and magnetic fields. (auth)

4386 EFFECT OF RADIAL PROFILE OF A CHARGED PARTICLE PULSE ON THE ELECTROMAGNETIC WAKE IN A PLASMA. Yadavalli, S. V. (Stanford Research Inst., Menlo Park, CA). Int. J. Electron.; 34: No. 4, 509-512(Apr 1973).

The variation of the self-magnetic field of a charged-particle pulse penetrating a uniform homogeneous plasma is studied as a function of the charge-density profile of the pulse. (auth)

4387 ELECTROSTATIC WAVES IN WARM RANDOM PLASMAS. Poularikas, A. D. (Univ. of Rhode Island, Kingston). Int. J. Electron.; 34: No. 4, 491-495(Apr 1973).

The propagation constants for electrostatic waves in warm plasmas with random electron density are developed. It has been found that for a collisionless plasma attenuation exists. Although the attenuation coefficient depends on the statistical condition of the plasma at all frequencies, the phase constant is relatively unaffected by randomness at frequencies far greater than the mean plasma frequency. Finally, the group velocity of the wave changes sign in the frequency range close to the mean plasma frequency. (auth)

4388 SPATIAL ECHO AND NONLINEAR INTERACTION OF WAVES IN A PLASMA. Vodyanitskii, A. A.; Repalov, N. S. Fiz. Plazmy Probl. Upr. Termoyad. Sin.; No. 3, 47-63(1972). (In Russian).

A spatial echo in a plasma is the nonlinear effect of a superposition of two or more plasma charged-particle beams that are modulated at different frequencies in spatially separated points. Nonlinear waves from two external charge-density disturbances are examined in a quadratic approximation with respect to the amplitudes of these disturbances, and the spatial echo is examined at all frequencies (including frequencies corresponding to nontransparent plasma regions) with allowance for electron and ion motion. An expression describing the echo signal for natural plasma oscillations is derived under the condition that at least one of the three frequencies (sources and echo) falls in the plasma transparency range. The nonlinear wave interaction signal is compared with the echo in the plasma. (IAA)

4389 INTERACTION BETWEEN HIGH-FREQUENCY FIELDS AND A PLASMA. Ivanov, A. A. Vop. Teor. Plazmy; No. 6, 139-209(1972). (In Russian)

A systematic review of the problems of the interaction between a collisionless plasma and high-frequency fields is given. The basic concepts of the theory are introduced, and a qualitative estimate is made of the effect of high-frequency fields on the plasma stability. The integration of the kinetic equations in the presence of high-frequency fields is then considered, and dispersion relations are obtained for a plasma interacting with various types of high-frequency fields. These dispersion relations are then investigated for a number of instabilities that are most dangerous from the standpoint of confinement of the plasma. Finally, a study is made of the effect of high-frequency fields on dissipative instabilities. (IAA)

4390 EXCITATION OF MAGNETOSONIC WAVES IN PLASMA WITH NONEQUILIBRIUM IONS. Sinitsa, N. G. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 1, 5-11(1973). (In Russian).

Excitation of rapid magnetoacoustic waves in plasma with nonequilibrium ions is considered under the conditions when their thermal motion along the constant magnetic field may be neglected. The growth rates of oscillations with the frequencies close to the ion-cyclotron frequency and its harmonics are determined. (auth)

4391 EXCITATION AND INTERACTION OF LOW-FREQUENCY OSCILLATIONS IN THE PRESENCE OF A BEAM INSTABILITY. Krivoruchko, S. M.; Kornilov, E. A. Fiz. Plazmy Probl. Upr. Termoyad Sin.; No. 3, 208-213(1972). (In Russian).

Previous studies of the beam instability show that the excitation of high-frequency oscillations in the vicinity of Langmuir frequencies is always accompanied by the excitation of low-frequency oscillations. The mechanism responsible for the excitation of the low-frequency oscillations was studied experimentally by employing modulation of the electron beam at several different frequen-

cies, and the results demonstrate that the low-frequency oscillations are a direct consequence of the beam instability. They result from nonlinear interactions between the high-frequency oscillations or from plasma inhomogeneity and loss of plasma equilibrium occasioned by the high-frequency fields. Multifrequency modulation of the beam can be used to control the spectrum of beam-instability oscillations or to transfer energy from the beam to plasma ions and electrons. (IAA)

4392 ELECTROMAGNETIC WAVE PROPAGATION IN A STRONGLY INHOMOGENEOUS WEAKLY IONIZED PLASMA. Kamenetskaya, G. Kh.; Kovner, M. S. (Gorky State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 1, 12-17(1973). (In Russian).

The propagation of electromagnetic waves through a strongly inhomogeneous plane-stratified plasma is considered when the inhomogeneity scale of the electron density L_N is comparable with the free path length l_{fr} and smaller or of the order of the wavelength λ. The known condition of neglecting the plasma density inhomogeneity $|\omega - i\nu| \gg (T/m)^{1/2} L_N^{-1}$ is shown to be sufficient but not necessary. Namely, at the oblique TE-wave incidence on the layer, the field E in a quasi-hydrodynamic approximation is described by the usual wave equation at arbitrarily large values of the density gradient. In the case of the oblique TH-wave incidence, the plasma inhomogeneity at $L_N \lesssim \lambda$ may be neglected at the limitation weaker than the above inequality. (auth)

4393 KINETIC THEORY OF WAVE REFLECTION AT THE OBLIQUE INCIDENCE ON THE BOUNDARY OF MAGNETOACTIVE PLASMA. Kondratenko, A. N. (Kharkov State Univ.). Izv. Vyssh. Ucheb. Zaved., Radiofiz., 16: No. 1, 18-24(1973). (In Russian).

The coefficients of reflection and surface absorption are found at the oblique incidence of linearly polarized waves on a half-bounded plasma being in a constant magnetic field perpendicular to the boundary. It appears that at the mirror-particle reflection for the case of weakly spatial dispersion, the surface absorption coefficient of s-polarized wave has a component proportional to the mean thermal velocity of particles that vanishes both at the normal incidence and in the isotropic plasma. The surface absorption coefficient of p-polarized wave at abnormal spin effect increases strongly with the incident angle, reaching the maximum value close to unity. (auth)

4394 ABSORPTION AND AMPLIFICATION OF ELECTROMAGNETIC WAVES IN A NONSTATIONARY MAGNETOACTIVE PLASMA TAKING INTO ACCOUNT SPATIAL DISPERSION. Avrov, A. I.; Smolyanskii, S. A. (Saratov State Univ., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 2, 171-180(1973). (In Russian).

The power density of local absorption of an electromagnetic wave in a classical multi-component and nonrelativistic plasma placed in a strong spatially homogeneous variable magnetic field is calculated. The expression for the power density averaged over the spatial and time variables is analyzed for the case of longitudinal and transverse (with respect to the direction of the external magnetic field) electromagnetic wave propagation. It is shown that under definite conditions the power density of the local absorption becomes negative. The values of the power density of the negative absorption are estimated for electron and ion plasma components. The dependence of the power density on the plasma temperature and the wavelength of a weak signal is analyzed, as well. (auth)

4395 DETERMINATION OF CORRELATORS OF ELECTROMAGNETIC FIELD FOR THE RESTRICTED PLASMA. Grechko, L. G. Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 3, 227-230(Mar 1973). (In Ukrainian).

The Green's function method was used to obtain the correlators of an electromagnetic field in plasma inhomogeneous media without considering space scattering and absorption. The efficiency of the method is compared with that of the method of applied forces for some concrete cases of bounded plasma. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 2681, 2694, and 3348.

4396 (AEC-tr-7421, pp 190-193) RBE OF HIGH-ENERGY BREMSSTRAHLUNG. Kovalev, V. P.; Kapchigashev, S. P.; Tsuladze, N. G. (Scientific Research Inst. of Medical Radiology, Obninsk, USSR). Apr 1973. Translated from Radiobiologiya; 12: No. 6, 942-944(1972).

Investigations of the RBE of bremsstrahlung with boundary energy 22 MeV at different depths of the tissue equivalent phantom were conducted. It was found that the value of the RBE at depths exceeding the maximum of the curve of the depth distribution of the dose remains constant, whereas close to the surface of the phantom a 25% increase in the relative biological effectiveness is observed. Investigations of the dependence of the RBE of bremsstrahlung on the boundary energy of the spectrum in the interval of E_{ym} 14 to 24 MeV were also conducted. An appreciable increase in the RBE is observed with increasing boundary energy of bremsstrahlung. (tr-auth)

4397 (BNL-tr-536) DETERMINATION OF THE ABSORPTION OF A MEDIUM WITHIN THE FRAMEWORK OF THE THEORY OF X-RAY TRANSITION RADIATION. Garibyan, G. M. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.) from Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 6: No. 1, 1-6 (1971). 7p. Dep. NTIS $3.00.

The effect of absorption in a laminar medium dependence on the number of transition-radiation photons emitted from it is determined for x-ray transition radiation produced in a stack of plates. (JFP)

4398 (EUR-4896(Vol.1), pp 1-23) NEUTRON DOSIMETRY BIOLOGY AND MEDICINE. Barendsen, G. W.; Broerse, J. J. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Values of the linear energy transfer (LET) of secondary particles produced by fast neutrons in biological materials, e.g., recoil protons and heavy nuclei, and alpha particles from nuclear reactions, cover a range in which the relative biological effectiveness (RBE) can vary considerably. The distribution of dose as a function of LET depends significantly on the neutron energy. As a consequence, the neutron energy spectrum, changes of this spectrum within an object and the atomic composition of this object are important factors which must be analyzed in order to provide an adequate specification of the energy deposition in biological systems. In addition, interaction of neutrons with tissue gives rise to γ-rays, which can contribute significantly to the absorbed dose. All these components can contribute to the total biological response, whereby the relative importance depends on the fraction of the total dose associated with each component and on their RBE values. For many effects in mammalian cells the RBE increases with decreasing neutron energy between 15 MeV and 0.1 MeV, but the values depend on the type of system and the end-points assayed. As a consequence, the precision with which the various components must be measured also depends on various factors, e.g., size and composition of the object, the dose, the dose rate, the neutron energy and the biological end-point. (auth)

4399 (EUR-4896(Vol.1), pp 25-41) SECONDARY-PARTICLE SPECTRA PRODUCED BY NEUTRON INTERACTIONS WITH TISSUE. Caswell, R. S.; Coyne, J. J. (National Bureau of Standards, Washington, DC). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Some basic aspects of neutron interactions with tissue are discussed: energy transfer to matter according to element present in the tissue and by type of charged particle produced; calculations of secondary particle spectra produced when neutrons interact with tissue for 1 and 14 MeV neutron energy. Both the primary spectra of secondary particles as produced in the nuclear reactions, and the softer "slowing-down" or "equilibrium" spectra after particle slowing down are determined. The relative importance of the various secondaries (p, d, α, Be, B, C, N, O) are discussed. These spectra provide physical input information for calculations of neutron energy deposition (examples given) and for models of neutron radiation effects on biological materials. (auth)

4400 (EUR-4896(Vol.1), pp 57-71) NEUTRON RADIATION QUALITY. Rossi, H. H. (Columbia Univ., New York). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Research in neutron radiobiology has disclosed considerable differences between the action of this radiation and that of the x and γ radiation traditionally employed in radiobiological research. These differences constitute significant information regarding the biological action of ionizing radiation in general and they need to be understood if neutron dosimetry is to be performed or applied effectively. The effects of neutrons and electromagnetic radiations on higher organisms are compared. (auth)

4401 (EUR-4896(Vol.1), pp 73-92) CHANGE OF RADIATION QUALITY IN A NEUTRON-IRRADIATED PHANTOM. Paretzke, H. G.; Gruenauer, F.; Maier, E.; Burger, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Munich). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Event size distributions were measured inside an elliptical phantom by use of a small Rossi type counter. The phantom was irradiated in free space and also with a narrow beam from a collimator. The neutrons were produced by the D, T-reaction at a 400 kV-Van De Graaff generator. For both experimental arrangements the local neutron spectra, the recoil particle spectra and the event size distributions in a small tissue volume of $2\mu^m$ diameter were calculated. For free space irradiation the event size spectrum in the Rossi counter was calculated and compared with the experimental results. Some problems of analysis of radiation quality based on track structure considerations are discussed. (auth)

4402 (EUR-4896(Vol.1), pp 93-109) ENERGY DEPOSITION PRODUCED BY FAST-NEUTRON IRRADIATION IN SMALL TISSUE EQUIVALENT VOLUMES. Bichsel, H.; Wootton, P.; Heintz, P. (Univ. of Washington, Seattle). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The distribution of ionizing events produced by fast neutron irradiation of volumes of cellular size was investigated. Both experimental and theoretical techniques were used. The purpose of the study was to perceive changes in the measured ionization spectra, e.g., with depth in a tissue equivalent medium. Presentation of the data in the form of graphs of $J^2N(J)$ versus log J were found to be particularly valuable in discovering spectral structure and the ratio $r(J) = [N_i(J)]/[N(J)]$ useful in demonstrating small modifications in N(J). Agreement between calculated and measured energy distributions was good, agreement being within ±15% for most cases. Several problems are unsolved: a) no corrections for straggling or counter resolution; b) inadequacies in stopping power data and in nuclear cross sections; c) no corrections for the energy dependence of W. In a theoretical study the energy dependence of W was shown to produce a significant deviation of observed ionization spectra N(J) from the energy deposition spectra F(T). The uncertainties in these factors made it impossible to detect and resolve any inaccuracies in the theoretical model. (auth)

4403 (EUR-4896(Vol.1), pp 117-136) PROBLEM OF TISSUE EQUIVALENCE FOR FAST NEUTRONS IN MICRODOSIMETRY. Booz, J.; Oldenburg, U.; Coppola, M. (Euratom, Ispra, Italy). Sep 1972. (In German).

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

In microdosimetry one is not primarily interested in the absorbed dose but in the frequency distribution of the energy imparted to small sensitive volumes. Therefore, in the context of microdosimetry the problem of tissue equivalence has to be analyzed anew. In this study two criteria of tissue equivalence in microdosimetry are defined which are related to two known microdosimetric hypotheses of radiation effect: the threshold hypothesis and the hypothesis of the dual radiation action. With the help of these criteria the tissue equivalence of Shonka-plastic and of various customary gas mixtures for neutrons of 0.6 to 6 MeV is examined. For this a Monte Carlo-program is used that calculates the spectral distribution of the energy imparted to spheres of 1 μm diameter for various neutron energies. The calculation is executed parallelly for tissue equivalent matter and for ICRU-tissue in such a way that the resulting differences are only due to the different atomic compositions and not to statistical errors. Spherical proportional counters of Shonka-plastic which are filled with tissue equivalent gas of Rossi and Failla simulating an effective diameter of 1 μm are sufficiently equivalent to ICRU-tissue for neutrons of 0.6 to 6 MeV, if the threshold hypothesis is used and if the biological threshold is so small that single events having a LET of about 100 keV/μm or less will produce the effect under consideration. If instead the hypothesis of the dual radiation action is used, then the above mentioned ex-

perimental set up is not tissue equivalent for neutrons of 3 to 6 MeV. It is also supposed that it is not tissue equivalent for higher neutron energies. (auth)

4404 (EUR-4896(Vol.1), pp 137-148) DETERMINATION OF THE AVERAGE ENERGY PER ION PAIR IN LIQUID N-HEXANE IRRADIATED WITH FAST NEUTRONS. Horneck, F. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Frankfurt am Main). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

A parallel plate ionization chamber filled with carefully cleaned liquid n-hexane was irradiated with D-T neutrons and D-D neutrons with energies of 13.5 MeV and 2.9 MeV. For these two different neutron energies the average energy necessary to produce one ion pair (W) in liquid n-hexane was determined. For this purpose: The saturation value of the ionization current was calculated by the theory of Jaffe approximated for high electric field strengths. The absorbed energy in the ionization chamber was received either by measuring the neutron fluence rate with activation methods or measuring the dose rate directly with gas ionization chambers. (auth)

4405 (EUR-4896(Vol.1), pp 149-157) NEUTRON-DOSIMETRY EXPERIMENTS USING A TISSUE-EQUIVALENT PROPORTIONAL COUNTER. Srdoc, D.; Breyer, B. (Inst. Rudjer Boskovic, Zagreb). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

An experimental method for measurement of dose equivalent in mixed radiation field is presented. The method is based on the measurement of energy deposition in a very small tissue-equivalent volume. The experimental arrangement consisting of a small, sealed off, tissue-equivalent counter and the associated electronics is described in some detail. The calibration of the counter, the gas gain stability and the processing of the pulse height spectra are discussed. The experimental results obtained by exposing the counter inside the spherical phantom to 14-MeV neutrons are presented. (auth)

4406 (EUR-4896(Vol.1), pp 159-176) DETERMINATION OF ABSORBED DOSE IN A FAST-NEUTRON BEAM BY IONIZATION AND CALORIMETRIC METHODS. Bewley, D. K. (Hammersmith Hospital, London); McCullough, E. C.; Page, B. C.; Sakata, S. Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The fast neutron beam from the MRC cyclotron (mean energy 7.5 MeV) has been calibrated in terms of Kerma to tissue from neutrons and contaminating γ rays. Three methods have been used: a tissue-equivalent calorimeter and two methods using ionization chambers. Films and TLD have also been used for the γ rays. The errors inherent in each method have been assessed. The three methods give mutually consistent results. The uncertainties are estimated to be: calorimeter plus film 4.6%, polythene/ethylene chamber plus film 5.9% and a difference method on two chambers 11.8%. (auth)

4407 (EUR-4896(Vol.1), pp 177-210) NEUTRON DOSIMETRY AT THE RADIOLOGICAL RESEARCH ACCELERATOR FACILITY. Goodman, L. J. (Columbia Univ., New York). Sep. 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The Radiological Research Accelerator Facility (RARAF) is engaged in extensive research employing fast neutrons for both radiological physics and radiobiology. A brief description of the overall scope of this project is given. Neutron dosimetry at RARAF is detailed with respect to four types of measurements; kerma, absolute dose, dose monitoring and quality constancy. A variety of special ionization chambers is discussed with respect to applications to specific problems encountered for neutron irradiations of different kinds of biological systems. These include the lens of the mouse eye, the mouse and rat body, Drosophila and Tradescantia. Examples are given illustrating the incorporation of chambers as an integral part of a phantom. A thin walled chamber is described for applications to attenuation measurements or for the determination of secondary particle build-up. The usefulness of employing internal gas multiplication to amplify the very low ionization currents normally encountered with small chamber volumes is discussed in relation to measurements where dose changes rapidly with spacial position. Discussion of RARAF dosimetry techniques is completed with a brief description of gamma ray dose measurements, spectrum and spectrum monitoring measurements, and an explanation of the digital dosimetry and dose control sytem employed. (auth)

4408 (EUR-4896(Vol.2), pp 627-647) DOSIMETRY OF D-T NEUTRONS FOR RADIOTHERAPEUTIC APPLICATIONS. Broerse, J. J.; Broers-Challiss, J. E.; Maruyama, T. (Radiobiological Inst. TNO, Rijswijk, Netherlands). Sep 1972.

From first symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

In order to obtain quantitative information on the effectiveness of fast neutrons for clinical applications, responses of pulmonary metastases in patients are being studied after irradiation with 15 MeV neutrons or γ-rays. Here, descriptions are given of the characteristics of the neutron source, the collimator design and the dosimetry methods employed. The dosimetry program is primarily concerned with depth dose measurements, using different phantoms of the upper part of the human body, in order to obtain knowledge of the beam profile and isodose curves within patients. The total absorbed dose at various sites was measured using tissue-equivalent ionization chambers, while an estimate of the γ contamination was derived using an additional chamber which was relatively insensitive to neutrons. Dosimetry data obtained from measurements with phantoms will be discussed and compared with those obtained in the actual patient irradiations. (auth)

4409 (EUR-4896(Vol. 2), pp 649-661) ENERGY DEPOSIT OF NEUTRONS IN HETEROGENEOUS PHANTOMS. Hehn, G.: Stiller, P.; Becker, R. (Univ., Stuttgart). Sep. 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The normal way of getting the isodose curves for radiation treatment is first of all to measure the dose distribution in tissue equivalent phantoms and then secondly to interpolate or to make a superposition of the experimental results by the computer. Effects on inhomogeneities in the human body are either not taken into account at all or in a way which is not sufficient. These inhomogeneities are not so difficult to deal with, if one lets the computer do the whole job. The energy deposit in the case of an irradiation of the head has been simulated with the computer. This has been done for a beam with 14 MeV neutrons and for comparison with Co-60-radiation and bremsstrahlung of a 10 MeV-betatron. For the energetic photons there was no great difference between the kerma in wet tissue and in bone regions, only a slight increase in bone. But for the neutrons we get a decrease of 25% in bone. That means that in neutron therapy the effect of inhomogeneity is more dominant than in the case of classical megavolt therapy. Details of the neutron energy deposit have been compared for two different neutron generators which are going to be used in W. Germany for therapy. (auth)

4410 (EUR-4896(Vol. 2), pp 673-700) DOSE AND LINEAR ENERGY TRANSFER WITHIN HUMAN BODY EXPOSED TO MIXED NEUTRONS AND γ RAYS OF THE CRAC SOURCE. Dousset, M.; Parmentier, N.: Soudain, G.; Bricka, M. (CEA, Fontenay-aux-Roses, France). Sep 1972. (In French).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

A comparison was made between the data resulting from measurements carried out within a solid man-shaped Plastinaut phantom exposed during the CRAC source divergence experiments, and the values of the dosimetric parameters calculated from the radiation field characteristics such as they are known presently in the most favorable conditions, during accidental divergence. The doses due to charged particles, and in some cases their distribution as a function of LET, were compared directly at some points of particular interest in the phantom, where small holes had been bored (dorsal and lumbar vertebrae, sternum, iliac bones). Besides, it has been possible to assess qualitatively the coherence of the data relating to γ doses gained from the three sources of information available: measurement of γ doses in air; measurement of total γ doses in the phantom; and calculation of doses due to secondary γ-rays generated by neutrons in the phantom. (auth)

4411 (EUR-4896(Vol. 2), pp 701-728) DOSE CALCULATION AND MEASUREMENT INSIDE A PHANTOM EXPOSED TO A DIRECTIONAL NEUTRON BEAM FROM THE FAST REACTOR HARMONIE. Ricourt, A.; Chemtob, M.; Veau, C.; Parmentier, N. C.; Calamand, D.; Jeandidier, C.; Leridon, A. (CEA, Fontenay-aux-Roses, France). Sep 1972. (In French).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Many problems are raised by the assessment of absorbed doses in the human body resulting from neutron exposures. The different methods which can be used to estimate the classical dosimetric parameters were applied to exposures to a directional beam of neutrons from a fast neutron reactor (Harmonie). The beam was chosen for two interesting characteristics: the incident γ dose can be practically neglected; the neutron spectrum is very characteristic (few thermal neutrons and no neutrons with energy over 2 MeV). Absorbed doses were evaluated in a manlike phantom, in two points corresponding to interesting medullary areas of a "plastinaut" man-shaped phantom and in a liquid phantom at

different depths. Three types of methods were used: 1. Calculation of different depth doses, on the basis of the data obtained by the Oak Ridge team using the Monte Carlo method. This calculation is made from the fluence and spectrum measured in air by activation spectrometers and recoil proton spectrometers. 2. Calculation of different depth doses, on the basis of results from spectrometric measurements at the respective depths; these doses correspond to the kerma whose value is numerically equal to the absorbed dose resulting from heavy charged particles. The (n,γ) component has been evaluated by ^{7}LiF and γ chamber measurements. 3. Direct measurement of the total absorbed dose at different depths with the use of Rossi tissue-equivalent chamber, together with measurements of the γ component by argon filled aluminum-walled chambers. The difference between both measurements gives a value of the absorbed dose resulting from heavy charged particles that can be compared to the previous values obtained. Together with these assessments of absorbed doses a study of dose distributions as a function of the LET was made either by calculation or experimental measurement. (auth)

4412 (EUR-4896(Vol. 2), pp 729-741) DOSIMETRY FOR RADIOBIOLOGICAL EXPERIMENTS WITH A 400-MeV NEUTRON BEAM. Baarli, J.; Sullivan, A. H. (CERN, Geneva). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

A neutron beam, of 400 MeV maximum energy and of about 3×10^5 n/cm^2/sec produced in the CERN Synchro-cyclotron, has been used for radiobiological experiments. The dose in the beam was estimated using tissue-equivalent ionization chambers, and the flux estimated from the activation of carbon in a plastic scintillator. The dose in an absorber placed in the beam builds up very rapidly and reaches a maximum at about 18 cm depth in water. This rapid rate of increase presents problems for the dose estimation to specific organs of the irradiated biological specimens. The contribution to the absorbed dose from the different interaction processes possible with the high energy neutrons changes with depth and this is reflected by a marked decrease in the ratio of high energy particle flux to absorbed dose with depth. The implications of the composition both for dosimetry and for the radiobiology are discussed. (auth)

4413 (EUR-4896(Vol. 2), pp 797-809) ENERGY SPECTRA OF CYCLOTRON-GENERATED FAST-NEUTRON BEAMS OF INTEREST TO RADIOTHERAPY. Mills, S. J.; Cowley, A. A.; Rautenbach, W. L. (National Physical Research Lab., Pretoria). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Neutron spectra are being measured for several fast-neutron-producing reactions, using a proton-recoil telescope at 0° to the incoming cyclotron beam. Spectra of deuteron- and helium-3-induced reactions on various thick, as well as thin targets are presented in the neutron energy range above 5 MeV, for various incident-particle energies. The possible use of these spectra to evaluate nuclear reactions for neutron therapy is briefly discussed, and it is pointed out that the lower-energy portions of the spectra will also have to be measured in order to calculate the actual depth doses from the spectra. (auth)

4414 (EUR-4896(Vol. 2), pp 743-755) FIELD MAPPING AND DEPTH DOSIMETRY IN THE JANUS HIGH FLUX IRRADIATION ROOM: FAST-NEUTRON FACILITY FOR BIOLOGICAL RESEARCH. Williamson, F. S.; Frigerio, N. A. (Argonne National Lab., IL). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The High Flux Irradiation Room of JANUS is approximately 4.4 m long, 2 m wide, and 2 m high. One long wall is curved and provided with shutters so that neutrons from a 200 kW (thermal) reactor can interact with a ^{235}U converter plate and provide a source of fission neutrons whose intensity may be varied by adjustments of reactor power. The room is used for the irradiation of up to 400 mice in one loading, at dose rates of up to 16 rads per minute of fast neutrons with a mean energy of 0.8 MeV and three % gamma dose contribution. The dose contribution to thermal neutrons is less than 0.05 percent. Depth dose data have been obtained for mouse phantoms. Absolute spectrum data have been used to gain insight into the angular distribution, and energy distribution, of neutrons incident on the experimental animals. Depth dose measurements and Monte Carlo computations have been compared for the case of a 16 cm cube of water, and confirm the angular and energy distributions. (auth)

4415 (EUR-4896(Vol. 2), pp 783-796) DOSE RATES, DEPTH DOSES, AND SPECTRA OF SOME CYCLOTRON-PRODUCED FAST NEUTRON BEAMS. Parnell, C. J. (Hammersmith Hospital, London). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Various reactions for the production of fast neutron beams with cyclotrons were examined. Reactions considered are the deuteron bombardment of beryllium targets thinner than the range of the incident deuterons and thick targets of lithium, carbon, and heavy water. The best depth doses were obtained with either a heavy water target or a beryllium target for which the thickness was approximately one quarter of the range of the deuterons. Fast neutron spectra of some of these beams are also included. (auth)

4416 (EUR-4896(Vol. 2), pp 839-847) INFLUENCE OF ATTENUATION AND SCATTERING OF RADIATION ON THE TOTAL DOSE AT ANY POINT FROM AN IMPLANTED ^{252}Cf SOURCE. Greene, D.; Major, D.; Meredith, W. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The Manchester System (Meredith 1967) for the design and dosimetry of interstitial and intra-cavity γ-ray treatments is based on the assumption that the dose distribution in a scattering medium near an implanted source is described by the inverse square law. An experimental investigation of the dose distribution near californium-252 sources is reported and the results are considered in relation to the above assumption. (auth)

4417 (UCID-16041) MEASUREMENTS OF THE ENERGY LOSS PER ION PAIR FOR ELECTRONS STOPPED IN CLOUD CHAMBER ATMOSPHERES. Hansen, N. E. (California Univ., Livermore. Lawrence Livermore Lab.). 2 Mar 1973. Contract W-7405-Eng-48. 11p. Dep. NTIS $3.00.

Ionization-chamber measurements of W_{β}, the mean energy expended per ion pair formed by an ionizing electron, are given (referred to W_{β} = 33.73 eV for electrons in dry air) for electrons in gases saturated with vapors of a 66/34 mixture by volume of ethyl alcohol and water. Measurements are reported for seven saturated gases for the temperature range 0°C to 30°C and for pressures 1000 Torr and 750 Torr. Values abstracted for 20°C and 750 Torr are: 26.8 eV in He, 26.2 eV in CH_4, 33.8 eV in N_2, 33.2 eV in air, 32.5 eV in CO_2, 28.6 eV in Ne, and 26.1 eV in Ar. (auth)

4418 LOW-ENERGY COMPONENTS OF SCATTERED γ RADIATION. Minato, S. (Government Industrial Research Inst., Nagoya, Japan). Nucl. Sci. Eng.; 51: No. 1, 32-40(May 1973).

Energy spectra resulting from the scattering of gamma rays under various conditions were calculated by a Monte Carlo method. As a result of systematic studies on the low energy components of the spectra, it was found that they were not affected very much by source energy or scatterer geometry but were affected by the atomic number of the scatterer. These properties could be explained successfully by a relatively simple theory including the continuous slowing-down approximation. A formula expressing the relationship between the position of the peak appearing in the low energy region of the spectrum and the atomic number of the scatterer was derived from the above calculations and the theory. (auth)

4419 STUDIES OF THE PASSAGE OF FAST ELECTRONS THROUGH THICK LAYERS OF MATTER. Roos, H.; Schulz, H. J.; Harder, D. (Univ., Wuerzburg, Ger.). pp 259-272 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

Systematic experiments, the results of which can serve as permanent references, are described. The relative transmission through Al, Cu, Cd, and Pb is shown as a function of relative absorber thickness. The curve shape is nearly uniquely dependent on the dimensionless parameter $Z\mu/T_0$, where μ is the electron rest energy, Z is the atomic number, and T_0 is the electron energy. The following "scaling law" was formulated: the solutions of the transport equation for different electron absorbers are identical in scaled coordinates (or geometrically similar in unscaled coordinates, with r_0, the mean electron path length, as a scale factor) provided that the parameter $Z\mu/T_0$ is the same and the boundary conditions are geometrically similar. With increasing absorber thickness the angular distributions are broadened by multiple scattering until a limiting case, "complete diffusion", is reached. Mean square scattering angles of 5- to 20-MeV electrons are shown after passage through thick layers of different absorbers. Spectra of 20-MeV electrons after passing through various thicknesses of C are shown; these results, typical for low-Z absorbers, are broader and shifted to lower energies as the thickness is increased. It is found that the decrease of the most probable energy with absorber thickness is practically linear. (12 figures) (RWR)

4420 ELECTRON SCATTERING EXPERIMENTS (TRANSMISSION THROUGH CRYSTALS AND NUCLEAR DISINTEGRATION). Harder, D.; (Univ., Wuerzburg, Ger.); Herkommer, E.; Mehling, R.; Bell, F.; Sizmann, R. pp 273-285 of Proceedings of the 5th International Betatron Symposium. Bucharest; Inst. for Atomic Physics (1971).

From 5th international betatron symposium; Bucharest, Romania (18 Oct 1971). See CONF-711068-.

A collimated beam of 20-MeV electrons was focused on MgO and Si targets of 10 to 100 μm thickness. A rocking curve and photographic positive are presented for MgO. The theoretical aspects of electron channeling are then discussed from both classical and quantum-mechanical points of view. The yield of secondary radiation like bremsstrahlung is strongly affected by electron channeling, because the distribution of impact parameters is changed. The experimental determination of the cross section for deuterium break-up by electrons at 5 to 18 MeV was also measured. The results are compared with theory. The emphasis in this part of the paper is on the experimental arrangement. (8 figures, 1 table) (RWR)

4421 RADIATION QUALITY AND ITS INFLUENCE ON BIOLOGICAL RESPONSE. Bewley, D. K. (Hammersmith Hospital, London). Brit. Med. Bull.; 29: No. 1, 7-11(Jan 1973).

The effect of radiation quality on biological response during radiotherapy is discussed in outline, and the literature briefly reviewed, under the following headings: (1) Specification of radiation quality with particular reference to LET (a) Correlation of response to neutrons and charged particles. (b) Microdosimetry. (c) Tract structure. (2) Variation of biological response with radiation quality. (a) RBE (examples are taken from track-segment studies of RBE and OER of human kidney cells as a function of L_∞, and RBE studies of fast neutrons for skin reactions). (b) Modifying agents. (c) Age-dependent sensitivity of cells. (d) Effects on cell division and growth. (3) Carcinogenesis. (UK)

4422 AIR LUMINESCENCE EXCITED BY RELATIVISTIC ELECTRONS. Volovik, V. D.; Kobizskoi, V. I.; Petrenko, V. V.; Popov, G. F.; Fursov, G. L. At. Energ. (USSR); 34: No. 2, 130-131(Feb 1973). (In Russian).

The dependence of ionized atmospheric fluorescence on the energy of relativistic electrons was investigated under conditions of good geometry (6×10^{-4} steradian $\cdot$ cm^2) using a beam of 20 to 1400 MeV electrons from a linear accelerator which operated in a pulsed regime with a repetition frequency of 50 Hz. The luminescence intensity fell slowly with increasing energy of the incident electrons, and without agreement with the path of the ionization loss curve. (KSW)

4423 SAFETY FEATURES ON X-RAY DIFFRACTION EQUIPMENT IN NEW ZEALAND. Robertson, M. K. (National Radiation Lab., Christchurch, New Zealand). Health Phys.; 24: No. 5, 547-551(May 1973).

A programme has been implemented to improve the standard of safety features on x-ray diffraction equipment in New Zealand. The results have greatly reduced this radiation hazard. (auth)

4424 DOSIMETRIC MEASUREMENTS WITH A Sr-^{90}Y BETA RAY SOURCE BONDED IN ALUMINUM. Haybittle, J. L.; Barber, R. W. (Addenbrooke's Hospital, Cambridge, Eng.). Phys. Med. Biol.; 18: No. 2, 272-275(Mar 1973).

A brief note is made of comparative measurements of bremsstrahlung exposure rates from β-rays absorbed in sources of two different constructions. An old type of β-ray source from a teletherapy unit, made of strontium carbonate bonded in silver, was compared with an improved source made of strontium titanate bonded in a plate of aluminium. Ionization chamber measurements showed an increase of β-ray output of 63%, although the activity of the source was only 9% higher. The intensity/energy relationship for the β-rays and bremsstrahlung from both sources was investigated. The new source provided relatively more low energy β-rays, but the quality of the bremsstrahlung remained the same. The measured exposure rate at 60 cm from the old source when the β-rays were absorbed in Perspex was $39 \pm$ mRh^{-1} Ci^{-1}. The corresponding rate measured with the new source was 21 ± 1 mRh^{-1} Ci^{-1}. (UK)

4425 CHARGE TRANSFER IN BIO-MOLECULAR DAMAGE BY LOW ENERGY PROTONS. Johnson, R. E.; Trevisani, E. T.; Harberger, J. H. (Univ. of Virginia, Charlottesville). Phys. Med. Biol.; 18: No. 2, 287-289(Mar 1973).

It is pointed out that when calculating the charge transfer contribution to biomolecular damage by low energy protons, the cross section involved should be multiplied by the charge state fraction, to account for the smaller effective proton doses in the material. The equilibrium charge state fraction, $F_{1\infty}$ is expressed as equal to $\sigma_{01}/(\sigma_{10} + \sigma_{01})$, where σ_{10} and σ_{01} are the cross-sections for neutralization (charge transfer) and ionization of a neutral beam particle respectively, averaged over the atomic constituents of the target material. Experiments with tissue-like material showed that this correction significantly affected the damage calculations even at energies as high as 100 keV, and below 5 keV the charge transfer damage by an equilibrium beam was almost an order of magnitude smaller than for a pure proton beam. It is briefly pointed out that applying this correction to other authors' results demonstrates that quasi-elastic damage will most likely dominate below 5 keV, and that the observed energy dependence in the inactivation cross-section for photons in RNase is not likely to be a result of the fragmentation by charge transfer. (UK)

4426 ISOTROPIC INCIDENT FLUX IN MONTE CARLO CALCULATIONS. Ritchie, R. H. (Oak Ridge National Lab., TN). Health Phys.; 24: No. 5, 571-572(May 1973).

When computing the dose delivered to phantoms by ionizing radiation, for example, difficulty arises as to the proper way to represent the isotropic fluxes of particles incident on the phantom in Monte Carlo computations. It is necessary to "weight" the incident particle by a factor cos θ where θ is the angle between the inward normal to the surface at the point of entry and the velocity vector of the incident particle. (UK)

4427 DETERMINATION OF GAMMA-RAY ABSORPTION COEFFICIENTS OF SOME CONSTRUCTION MATERIALS. Cameras Ross, R. A. Mexico City; Univ. Nacional Autonoma de Mexico (1972). 56p. (In Spanish).

Thesis.

The γ radiation absorption in an energy interval from 0.1 to 1.774 MeV was measured for construction materials commonly used in Mexico: woods, various types of partitions, concrete, cements, gypsum, lucite, glass, and basalt blocks. The woods studied were pine, cedar, mahogany, and holm-oak. The absorption coefficients are first defined and some of the phenomena occurring in the interaction of γ radiation with matter are analyzed. The experimental method is then described with details of the equipment used, the collimation geometry, radiation sources, materials used, and statistical adjustments. The linear absorption coefficient between the energy of the γ rays is given graphically for each of the materials studied. A comparative table of the different mass absorption coefficients is also given. The limitations on the use of these values are briefly discussed. (JSR)

4428 TRANSVERSE AND DEPTH-DOSE-DISTRIBUTION IN 42 MeV X-IRRADIATION. Nuesslin, F. (Medizinische Hochschule, Hanover). Strahlentherapie; 145: No. 2, 143-146 (1973). (In German).

The transverse distributions of doses were measured and the qualities of the compensation screens were tested on a Siemens betatron, under 42 MeV x-ray radiation and a FSD of 100 cm. Moreover, the percental depth doses were determined, in relation to the field size and compensating screen in a water depth ranging between 0.5 and 40 cm. (GF)

4429 MEASUREMENT OF ABSORBED DOSE IN A PHANTOM IRRADIATED BY A SINGLE BEAM OF X OR GAMMA RAYS. ICRU Report 23. Washington, DC; International Commission on Radiation Units and Measurements (1973). 30p.

Practical radiation beam dosimetry is reviewed and recommendations on methods for the establishment of the absorbed dose at any point in the patient are formulated. First, a determination of the radiation is made at the calibration point. Secondly, the peak absorbed-dose rates—or, for low energies, the surface absorbed-dose rates—are deduced either by relative measurements or, with the aid of published depth-dose tables. The absorbed-dose rate at any point of interest is related to the peak or surface absorbed-dose rate by the use of appropriate standard depth-dose tables and isodose charts. (MHR)

4430 ABSOLUTE ACTIVITY DETERMINATIONS AND DOSE RATE MEASUREMENTS OF THERAPEUTIC ^{198}Au AND ^{131}I. Klein, J. (Medizinische Akedemie, Magdeburg, Ger.). Radiobiol.-Radiother.; 14: No. 1, 37-44(1973). (In German).

An absolute activity determination of the delivered 50 mCi ^{131}I and 100 mCi ^{198}Au samples, respectively, is shown to be possible in the clinical practice by a dose rate measurement by means of the VA-J-18 and the spherical ionization chamber VA-K-253 if some simple corrections are considered. The measurements can be made under defined geometrical conditions for radioprotective reasons in the shielding castle VA-H-16. An additional scattering factor depending on the distance compared with a free-air measurement practically without scattering can there easily be considered. The accuracy of the activity may reach in favorable cases given in this paper the dose measuring accuracy of the VA-J 18 (about 4 to 5%). (auth)

4431 ELECTRON ENERGY DEPOSITION IN A GASEOUS MIXTURE. Peterson, L. R.; Sawada, T.; Bass, J. N.; Green, A. E. S. (Univ. of Florida, Gainesville). Comput. Phys. Commun.; 5: No. 4, 239-262(Apr 1973).

This program apportions the energy deposited in various atomic and molecular excitations and ionizations when an electron impinges upon a prescribed mixture of gases. The basic electron impact cross sections for each species are inserted using parameterized forms which have been found to adequately represent such data. Relative populations and excitation efficiencies for all atomic or molecular states are computed following the complete energy degradation of the primary electron and all generations of secondaries formed during ionization events. (auth)

4432 CALCULATION OF THE RADIAL DISTRIBUTION OF EMITTERS IN A CYLINDRICAL SOURCE. Piessens, R. (Univ. of Leuven, Heverlee, Belgium). Comput. Phys. Commun.; 5: No. 4, 294-298(Apr 1973).

This program determines the radial distribution of the emission coefficient from measured spectral intensity distributions emitted by an extended source of radiation. It is assumed that the source is optically thin and axially symmetrical. (auth)

4433 NUMERICAL SOLUTION OF THE ELECTRON DIFFUSION EQUATION. Early, R. A. (Stanford Univ., CA). Nucl. Instrum. Methods; 109: No. 1, 93-100(1973).

A numerical solution to the integro-differential equation describing the energy distribution of a beam of electrons which has passed through matter, losing energy by radiation only, has been obtained utilizing a finite difference mesh method. Solutions were obtained for thicknesses of up to 0.1 radiation lengths for a complete screening approximation to the energy loss equation. The accuracy of the method was checked by comparison of results with known solutions to the diffusion equation. The formulas of Mo-Tsai and Tsai for electron straggling distributions were compared to the numerical results. Good agreement was found near the high energy end of the distribution, the numerical results being within two percent of the theoretical predictions. At the low energy end of the distribution, the numerical results differ from those predicted by as much as eight percent at thicknesses of 0.1 radiation length. The disagreement was found to be proportional to thickness traversed by the beam. (auth)

4434 CALCULATION OF THE VAVILOV DISTRIBUTION ALLOWING FOR ELECTRON ESCAPE FROM THE ABSORBER. Badhwar, G. D. (Manned Spacecraft Center, Houston, TX). Nucl. Instrum. Methods; 109: No. 1, 119-123(1973).

The probability distribution for energy deposition in absorbers allowing for electron escape was obtained. A computer program to calculate the distribution is given. (auth)

4435 END OF THE RAD. Dewey, D. L. (Mount Vernon Hospital, Northwood, Eng.). Brit. J. Radiol.; 46: No. 544, 320 (Apr 1973).

Brief comment is made on a previous editorial (Br. J. Radiol. (Oct 1972)), concerning changes in the radiological field in relation to the SI system of units. It is pointed out that it is possible to conform to the system by using Hectorads (Hrad) for absorbed dose rate and disintegrations/sec instead of the curie. It is suggested that the use of coulomb/kilogram for exposure dose and ampere/kilogram for exposure rate is in error and based on the traditional way of measuring röntgens. It is pointed out that the röntgen is not really exposure dose but a measure derived from the absorbed dose in air and it is suggested that this unit should be retained. (UK)

4436 EXPERIENCE WITH POSITIVE BEAM LIMITING SYSTEMS ON DIAGNOSTIC RADIOGRAPHIC EQUIPMENT. Kerrigan, G. M.; Peyser, L. F. (Machlett Laboratories, Inc., Springdale, CT). Amer. J. Pub. Health; 62: No. 10, 1391-1393 (Oct 1972).

Experience with two basic systems to automatically reduce the size of the x-ray beam to the size of the film is discussed. (MHR)

Radiation Protection Standards

4437 (EUR-4896(Vol. 2), pp 855-861) RADIATION QUANTITIES AND UNITS. Wyckoff, H. O. (International Commission on Radiation Units and Measurements, Washington, DC). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

In its recent Report 19, the International Commission on Radiation Units and Measurements has distinguished between nonstochastic and stochastic radiation quantities. The magnitude of stochastic quantities varies discontinuously in space and time and the gradient and rate of such quantities are not determinable. The magnitude of nonstochastic quantities varies continuously in space and time and the gradient and rate of such quantities are determinable. The ICRU has defined three stochastic quantities which are of use in the field of ionizing radiation. These are the energy imparted, the specific energy and the lineal energy. The relation between these and their associated nonstochastic quantities is developed. (auth)

4438 (EUR-4896(Vol. 2), pp 863-871) QUANTITIES AND UNITS IN NEUTRON DOSIMETRY. Wagner, S. (Physikalisch-Technische Bundesanstalt, Brunswick). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

The meaning of quantities and units used in physical measurements is discussed and the requirements for quantities and units to be used in neutron dosimetry for medicine and biology are established. Following these principles, the quantities exposure, absorbed dose, dose equivalent, relative biological effectiveness and quality factor, kerma, and first collision dose are commented upon. (auth)

4439 (EUR-4896(Vol. 2), pp 873-896) DOSE EQUIVALENT AND QUALITY FACTOR OF RADIATION FROM HIGH-ENERGY ACCELERATORS. Hoefert, M. (CERN, Geneva). Sep 1972.

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

Health Physics measurements around high energy accelerators are difficult because of the varying composition of radiation fields. The presence of neutrons as well as charged particles above 10 MeV contributing considerably to the total dose means another complication. Thus concepts in the field of radiation protection are under constant review and have to be adapted to the assessment of radiation risks in accelerator installations. Some criticism voiced in the past and concerning the application of quantities has been overcome to a great extent with the Publication 15 of the ICRP. Definitions of dose equivalent and quality factor are now unambiguous and straightforward and different propositions for the assessment of the two quantities in mixed radiation fields including high energy are outlined in this publication. Taking radiation protection measurements made near the CERN accelerators as an example, it will be shown that there is no need for introducing new concepts like the dose equivalent index as presented recently in the ICRU Publication 19. Practical results will rather call for logical simplifications allowing for better correlations between survey methods (anticipatory measurements) and methods used for the control of exposure to individuals (simultaneous measurements) than justify the introduction of new complications. (auth)

4440 GOVERNMENTAL SPECIAL STANDARD OF THE UNIT OF MASS OF RADIUM. Karavaev, F. M.; Khol'nova, E. A.; Drichko, A. F.; Kul'kova, L. P. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 11, 1600-1604(Nov 1972).

Translated from Izmer. Tekh.; 15: No. 11, 5-8(Nov 1972).

The history and accuracy of the governmental special standard of the unit of mass of radium are discussed. (auth)

Radiation Source Calibration and Standardization

Refer also to abstracts 2862-2868, 2875, and 2876.

4441 (CEA-R-4435) INTERLABORATORY MEASUREMENT OF THE ACTIVITIES OF RADIONUCLIDES ^{137}Cs, ^{60}Co, ^{54}Mn, ^{141}Ce, AND ^{57}Co. Perolat, J. P.; Legrand, J.; Thenard, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1973. 33p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

Five interlaboratory tests were organized in 1971 by the LMRI on a national level concerning the measurement of five γ emitter solutions of ^{60}Co, ^{54}Mn, ^{137}Cs, ^{141}Ce, and ^{57}Co. About 15 laboratories, most of them not being specialist in radioactivity measurements, participated in these tests; either semiconductor or NaI (Tl) detectors were used. The results, where the laboratories remain anonymous, show that, for the energetic γ emitters ^{60}Co, ^{54}Mn, and ^{137}Cs in the activity range from 0.5 to 50 μCi/ml, there is no difficulty in obtaining an accuracy of about 4 per cent, even for a nonspecialist laboratory. In the case of the two radionuclides ^{57}Co and ^{141}Ce with γ energies below 150 keV, the results are less satisfactory. Suggestions are made to improve the accuracy of the relative measurement for these two radionuclides in order to obtain better accuracies, as in the case of the energetic γ emitters. (10 figures, 13 tables) (auth)

4442 (EUR-4896(Vol. 2), pp 469-509) NEUTRON SPECTROMETRY AND SOURCE CALIBRATION. Capgras, A.; Ronteix, C.; Sueur, M. (CEN de Saclay, Gif-sur-Yvette, France). Sep 1972. (In French).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

After defining the parameters characterizing a neutron field, the authors describe a recoil-proton proportional counter spectrometry method used for spectral determination of (α,n) sources and of spontaneous fission. The limits to the use of such a method are defined, and the results obtained for Am-Li and Am-F sources are discussed and compared with the experimental and theoretical results obtained by other authors. The measurement of neutron fluence is dealt with based on the $H(n,\alpha)$ D reaction, with thermal neutrons. This method, although relative, has the great advantage of attaining intensity levels of about 10^3 n/s/4, and it has been used to calibrate cardiac stimulators. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 3398, 3399, and 4500.

4443 (CEA-CONF-2191) PARTICULAR PROPERTIES OF PROTECTIVE CONCRETE INFLUENCING THE ATTENUATION PROCESS OF RADIATIONS. Dubois, F. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). [nd]. 19p. (In French). (CONF-721018-19). Dep. NTIS (U.S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The use of concrete as shielding material in nuclear reactors has shown, that a better knowledge of its nature could, in an important way improve results of radiation attenuation calculation. Hydrogen and some absorbent materials of slight ponderable importance, as well as the knowledge of the evolution of water contents in hydraulic binders and aggregates play a preponderant part in the choice of concretes. Studies made by C.E.A. of the different kinds of special shielding concrete as a function of temperature, concrete thickness, its mineralogical composition, favoured the wide use of these materials in reactor shielding. This paper is a synthesis of all the work done by C.E.A. in order to obtain particular properties for the shielding material in every case and thus find an answer to the rigorous working conditions of nuclear plants. (auth)

4444 (CONF-721018-23) SHIELDING OPTIMIZATION BY DIFFERENTIAL DYNAMIC PROGRAMMING METHOD AND EXPERIMENT. Kanai, Y.; Yamaji, A.; Takeuchi, K. (Ship Research Inst., Tokyo (Japan)). 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

A dynamic differential programming method is presented. The method is used to determine the optimum shielding system by minimizing a performance criterion, this criterion being represented as a linear combination of three functions concerning weight, cost, and thickness or dose, subject to certain constraints. A linear differential approximation is used to calculate the radiation attenuation, 7 groups being used for the neutrons and gamma rays. The theoretical and experimental determination of the optimum configuration for a laminated iron-water shield are discussed. (France)

4445 (HASL-272) TRANSMISSION OF GAMMA RAYS THROUGH ALUMINUM AND LAMINATED LEAD-ALUMINUM SLABS. Burke, G. de P.; Bennett, B. G.; Beck, H. L. (Health and Safety Lab. (AEC), New York). Mar 1973. 18p. Dep. NTIS $4.00.

The differential energy and angle spectra of gamma rays penetrating aluminum and laminated slabs from a normally incident broad beam produced by a collimated 4 Ci ^{137}Cs source were measured with a NaI(Tl) spectrometer system. Experimental data obtained at an angle of 45° from the incident axis for a one mean free path (mfp) aluminum slab are compared with Monte Carlo calculations and also with a DP1 polynomial expansion method of calculating the low energy portion of the spectrum. The laminated slab combinations investigated were one mfp of aluminum followed by one of lead, and one mfp of lead followed by one of aluminum. Experimental data were obtained and Monte Carlo calculations performed for both combinations at 18, 26, 37 and 60° from the incident axis. The agreement was within the experimental and calculational error estimates and supports the validity of both techniques for investigating laminated slab shielding problems. (auth)

4446 (N-73-12700) SHIELDING APPLICATION OF PERTURBATION THEORY TO DETERMINE CHANGES IN NEUTRON AND GAMMA DOSES DUE TO CHANGES IN SHIELD LAYERS. Fieno, D. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Nov 1972. 44p. (NASA-TN-D-7093) NTIS.

Perturbation theory formulas were derived and applied to determine changes in neutron and gamma-ray doses due to changes in various radiation shield layers for fixed sources. For a given source and detector position, the perturbation method enables dose derivatives with respect to density, or equivalently thickness, for every layer to be determined from one forward and one inhomogeneous adjoint calculation. A direct determination without the perturbation approach would require two forward calculations to evaluate the dose derivative due to a change in a single layer. Hence, the perturbation method for obtaining dose derivatives requires fewer computations for design studies of multilayer shields. For an illustrative problem, a comparison was made of the fractional change in the dose per unit change in the thickness of each shield layer in a two-layer spherical configuration as calculated by perturbation theory and by successive direct calculations; excellent agreement was obtained between the two methods. (auth) (STAR)

4447 (SLA-73-184) REDUCTION OF NEUTRON DAMAGE IN SILICON BY THICK SHIELDS OF IRON, TUNGSTEN, AND POLYETHYLENE. Ewing, R. I.; Renken, J. H.; Adams, K. G. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 12p. Dep. NTIS $3.00.

A neutron transport code was used to calculate the effectiveness of 3 feet of shielding material in reducing the damage in silicon caused by incident neutrons of energies 10 and 1 MeV respectively. Materials considered are iron, tungsten, and polyethylene. (auth)

4448 (ZJE-127) SOLUTION OF RADIATION TRANSPORT IN SHIELDING BY THE ANALYTICAL METHOD USING FUNCTIONS OF MATRIX ARGUMENT. Valenta, V. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 79p. Dep. NTIS (U. S. Sales Only) $6.00.

An analytical solution of gamma and neutron transport in shielding by the S_N method, without iterations, using the matrix functions for a slab geometry is presented. A generalization of ideas of DAVYDOV and SHIKNOV for the case of external sources has been carried out. The relation to the method of discrete coordinates and that to the $2P_N$ method is shown in the discussion of the different ways of integration of scattering term. The comparison with the method of ARONSOV and YARMUSH shows the close relation to the method of transmission and reflection based on the invariance principle. It is pointed out the possibility to extend the suggested system for geometries with the axis symmetry using the VLADIMIROV method based on the determination of characteristics of differential part of operator of the kinetic equation. Simultaneously, the relation to the solution of Boltzmann equation by means of the Lie series is shown. (auth)

4449 (ZJE-133) USING THE METHOD OF SPHERICAL HARMONICS FOR THE CALCULATION OF SHIELDING. Part 2. The $2P_n$ Approximation. Hep, J.; Valenta, V. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 131p. Dep. NTIS (U. S. Sales Only) $8.75.

A general formulation of the method of solving the kinetic equation is presented for a plane geometry and a laminated arrangement by an expansion into series using the technique of orthogonal polynomials. The main attention is given to the $2P_n$ approximation which is compared with the P_n approximation. Other comparisons between the $2P_0$ and the P_1, and between the $2P_1$ and the P_3 approximations are performed in more detail. A transition to the $2P_n$ system is also described. The work should serve as a practical manual for solving the group system of equations in the $2P_n$ approximation. It contains instructions for obtaining the analytical expression for solving the equations in the $2P_n$ approximation, as well as the numerical method of the calculation. A generalization of the $2P_n$ approximation (after Pomraning and Baraf) is also presented. (auth)

4450 (ZJE-134) USING THE METHOD OF SPHERICAL HARMONICS FOR THE CALCULATION OF SHIELDING. Part 3. Generalized P_n Approximation. Valenta, V.; Veverka, O. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 76p. Dep. NTIS (U. S. Sales Only) $6.00.

A derivation of generalized P_n approximation for a plane geometry is presented. The boundary conditions are discussed in detail, and the instructions for the P_1, M_1, and A_1 approximations are given. Individual approximations are compared for a particular

case of an infinite homogeneous medium with an isotropical plate source. At the end the applicability of generalized approximations for shielding calculations is discussed. (auth)

4451 GAMMA RAY BUILDUP FACTOR FOR SPHERICAL SHIELDING. Zharkov, V. A.; Chudotvorov, A. A.; Kolesnikov, A. F. At. Energ. (USSR); 34: No. 2, 128-130(Feb 1973). (In Russian).

Dose buildup factors of γ radiation on the surfaces of spherical shielding were measured, and the dependence of the buildup factor on the shield-detector distance was investigated. Experiments were conducted with two Al spheres with diameters of 12 and 25 cm, at the centers of which was placed a practically point source of ^{137}Cs. A scintillation spectrometer with a stilbene crystal served as the detector of γ-radiation. The theoretical curve in both cases satisfactorily described the aggregate of experimental points. (KSW)

PHYSICS (THEORETICAL)

General

4452 MONODROMY RINGS OF THE NECKLACE GRAPHS. Regge, T. (Inst. for Advanced Study, Princeton, NJ); Speer, E. R.; Westwater, M. J. Fortschr. Phys.; 20: No. 6, 365-420(1972).

A necklace graph is a Feynman graph obtained from a single loop graph by replacing each internal line by a multiplet (i.e. a set of one or more internal lines joining the same two vertices). The monodromy rings of the necklace graphs are determined. (auth)

4453 REALIZATIONS OF LIE ALGEBRAS AND THE ALGEBRAIC TREATMENT OF QUANTUM PROBLEMS. Cordero, P.; Ghirardi, G. C. (Univ. of Chile, Santiago). Fortschr. Phys.; 20: No. 2, 105-133(1972).

An introduction is given to the use of algebraic methods in quantum physics. After defining concisely the different algebraic methods, emphasis is placed on a general mathematical scheme from which all known results on the subject can be derived. This is obtained by studying and solving first of all the general problem of building up realizations of Lie algebras in terms of canonically conjugated pairs of variables. Explicit formulas giving the most relevant realizations are given. Applications of the general formalism are then discussed, showing how it is possible to get all known algebraic results in quantum mechanics based on the use of symmetry algebras, spectrum generating algebras, and dynamical algebras in a very simple and unified way. (LBS)

4454 TRANSITION MOMENT INTEGRALS AND THE HYPERVIRIAL THEOREM. Pt. 2. Nash, J. C. (Oxford Univ.). J. Phys., B (London); 6: No. 3, 393-397(Mar 1973).

Hypervirial theorems for the operator $W = \exp(it\chi)$ for one-dimensional systems described by potentials involving only positive powers of χ have been shown to lead a recurrence relation in the transition moment integrals $T_n = (A, \chi^n B)$ where A and B are eigenstates of the system in question. This recurrence relation is also directly derived from other hypervirial theorems. Transition moments calculated in this way compare favorably with those obtained by direct computation. (auth)

4455 LAGRANGIAN QUANTUM THEORY. Bloore, F. J.; Routh, L.; Underhill, J. (Univ. of Liverpool). Nucl. Phys.; B55: No. 2, 637-647(1973).

A consistent Lagrangian quantum theory for one degree of freedom based on the Fréchet derivative is presented. A quantum mechanical system with one independent coordinate q and Lagrangian $L(q,\dot{q}) = a(q)\dot{q}^2 + b(q)\dot{q} + c(q)$. In a consistent quantum theory, the canonical equal-time commutation relation (c.c.r), $[q,\dot{q}] = i/2a(q)$ must be preserved in time; that is to say $[q,\ddot{q}] = (i/2a)$. Now the acceleration $\ddot{q}$ is given in terms of q and $\dot{q}$ by the Euler–Lagrange equation: the precise form of this depends on which variations δq are assumed to leave the action stationary. It is shown that the constraint that $\ddot{q}$ preserve the c.c.r. restricts the class of allowable variations of q for which the action integral is stationary to functions of the form $\delta q(q,t) = g(t)(a(q))^{-\frac{1}{2}}$ where g(t) is a c-number function which vanishes at the end-point of the time interval. This specification retains its form under a change of variable $q \rightarrow q(r)$. Thus unless the coefficient a(q) is a constant, c-number variations are not permissible. This means that the Euler–Lagrange equation of motion is not the naive form with c-number variations which is usually assumed. Noether's theorem, which relates the invariance of a Lagrangian under an infinitesimal coordinate transformation to an associated conserved quantity, only holds if the infinitesimal transformation is an allowable variation, that is to say one for which the action is stationary. It is proved that only variations of the form $a^{-\frac{1}{2}}$ can leave the Lagrangian invariant, so that the possibility of an invariance of L unaccompanied by a conserved quantity is removed. A Hamiltonian $H(q,\dot{q})$ is given which generates the time transformations given by the Euler–Lagrange equation. Finally, the allowability condition is shown to be the condition for which rearrangement of terms in the Lagrangian by means of the c.c.r. does not alter the ultimate Euler–Lagrange equation of motion. (auth)

4456 MECHANICAL INSTABILITY OF A DEGENERATE CHARGED FERMION FLUID. De Llano, M. (International Centre for Theoretical Physics, Trieste, Italy). J. Phys., C (London); 6: No. 6, L121-L124(28 Mar 1973).

By using the virial and Ferrell (Phys. Rev. Lett.; 1: 443(1958)) theorems, it is shown that the "jellium" model becomes mechanically unstable if the kinetic energy decreases faster than r_s^{-1} for large r_s. The consequences of a Maxwell construction relevant to the new phase are discussed. (auth)

4457 PHYSICAL INTERPRETATION OF WAVE MECHANICS. I. Janossy, L. (Central Research Inst. for Physics, Budapest). Found. Phys.; 3: No. 2, 185-202(Jun 1973).

Summarizing and extending previous ideas an attempt is made to show that the wave equation of the one-body problem can be transformed into a system of equations describing the motion of a deformable medium carrying charge and having permanent magnetic polarization. The wave equation and the system of transformed equations are connected by a strict one-to-one correspondence. The transformation which is not uniquely determined from a mathematical point of view can be chosen so that the new variables have direct physical significance. The latter requirement permits consequently a unique choice of the mathematical possibilities. (auth)

4458 CAN THE STATISTICAL POSTULATE OF QUANTUM THEORY BE DERIVED? A Critique of the Many-Universes Interpretation. Ballentine, L. E. (Simon Fraser Univ., Burnaby, B. C.). Found. Phys.; 3: No. 2, 229-240(Jun 1973).

The attempt to derive (rather than assume) the statistical postulate of quantum theory from the many-universes interpretation of Everett and De Witt is analyzed. The many-universes interpretation is found to be neither necessary nor sufficient for the task. (auth)

4459 RELEVANCE OF TIME-DELAYED COINCIDENCE MOESSBAUER EXPERIMENTS FOR THE INTERPRETATION OF THE UNCERTAINTY PRINCIPLE. Tefft, W. E. (Univ. of Missouri, Rolla). Found. Phys.; 3: No. 2, 255-263(Jun 1973).

Time-delayed coincidence Mössbauer experiments, in which the spread in energy may be either greater or less than the natural linewidth, are discussed. This discussion leads to the conclusion that in the uncertainty relation $\Delta E\,\Delta t \geq \hbar/2$, Δt should be interpreted as the duration time of the measurement and not as the lifetime of the state. Further analysis shows that confinement of photons to the region of space between emitter and absorber should cause a frequency spread much larger than actually observed. This leads to the conclusion that to think of photons as being created at one point in space, traveling with the velocity of light to another point, then being absorbed or destroyed, is incorrect. (auth)

4460 LOGICS FOR QUANTUM MECHANICS. Strauss, M. Found. Phys.; 3: No. 2, 265-276(Jun 1973).

The two concepts of probability used in physics are analyzed from the formal and the material points of view. The standard theory corresponds to prob_1 (probability of the coexistence of two properties). A general logicomathematical theory of prob_2 (probability of transition between states) is presented in axiomatic form. The underlying state algebra is neither Boolean nor Birkhoff–von Neumann but partial Boolean. In the Boolean subalgebras, prob_1 theory holds. The theory presented contains the logicomathematical foundations of quantum mechanics and, as degenerate cases, the theories of stochastic games and of Markov chains. (auth)

4461 QUANTUM THEORY AS AN INDICATION OF A NEW ORDER IN PHYSICS. B. Implicate and Explicate Order in Physical Law. Bohm, D. (Birkbeck Coll., London). Found. Phys.; 3: No. 2, 139-168(Jun 1973).

A further inquiry is made into the question of the emergence of new orders in physics, first raised in an earlier paper. In this inquiry, one is led to suggest that the quantum theory indicates the need for yet another new order, which is called "enfolded" or "implicate." One of the most striking examples of the implicate order is to be seen by considering the function of the hologram, which clearly reveals how a total content (in principle extending over the whole of space and time) is "enfolded" in the movement of waves (electromagnetic and other kinds) in any given region. One then comes to the notion that the quantum theory indicates that this implicate order is not merely a dependent or fortuitous feature of the content, but rather, that it should be considered as the independent ground of existence of things, while the ordinary explicate order is what should be considered as dependent. Finally, it is pointed out how the implicate order is expressed naturally in terms of an algebra similar to that of the quantum theory, which is, however, subject to generalizations going beyond the limits of what has meaning in this theory. Various new directions of further research are indicated. (auth)

4462 MOMENTUM TRANSFER CROSS SECTIONS AND THE Z_1 OSCILLATIONS IN STOPPING POWER. Briggs, J. S.; Pathak, A. P. (United Kingdom Atomic Energy Authority, Har-

well, Eng.). J. Phys., C (London); 6: No. 7, L153-L157(12 Apr 1973).

Heavy ions moving at low velocity along channelling directions in crystals are considered to lose energy by transferring momentum to target electrons which scatter elastically from them. In a model system of an atom moving through an electron gas, the stopping power is shown to be proportional to the electron momentum transfer cross section. The variation of this cross section throughout the periodic table corresponds closely to the observed variation of stopping power for channelled ions. (auth)

4463 HARMONIC OSCILLATOR. Values of the SU(3) Invariants. Hughes, J. W. B. (Queen Mary Coll., London). J. Phys., A (London); 6: No. 4, 453-458(Apr 1973).

Formulas are given relating the Hamiltonian of the three-dimensional harmonic oscillator to the second and third order invariants I_2 and I_3, respectively, of its symmetry group SU(3). For those irreducible representations which are realized by wave functions of the harmonic oscillator, I_2 and I_3 are diagonal operators satisfying the relation $6I_3 = I_2(4I_2 + 1)^{\frac{1}{2}}$. (auth)

Quantum Field Theories

Refer also to abstract 3884.

4464 (COO-2271-6) RENORMALIZATION METHOD: A DIFFERENT OUTLOOK, AND THE ENERGY-MOMENTUM TENSOR IN THE $g\pi^4$ THEORY. Poggio, E. C. (Columbia Univ., New York. Dept. of Physics). 1973. 71p. Dep. NTIS $5.75.

A new method of renormalizing a quartic self-interacting boson theory has been developed. The need to introduce a Lagrangian with counterterms and renormalization constants is avoided and a simple and compact set of computational rules results. As a consequence of the propagator function analysis, one is able to renormalize explicitly the field energy-momentum tensor to all orders. One finds a one-parameter family of renormalizable tensors, none of which is the one proposed by Callan, Coleman and Jackiw. The method will allow for a simple determination of the asymptotic "zero-mass" theory. (auth)

4465 (COO-2271-7) SHORT-DISTANCE BEHAVIOR OF A $g\phi^4$ THEORY, AND CONFORMAL INVARIANT FOUR-POINT FUNCTIONS. Poggio, E. C. (Columbia Univ., New York. Dept. of Physics). 1973. 55p. Dep. NTIS $4.75.

The "zero-mass" limiting short-distance theory for the $g\phi^4$ interaction is explicitly constructed. The propagator is computed to third order and the vertex to fourth order in $\bar{g}$, the zero-mass coupling constant. The Gell-Mann and Low short-distance equations which result as exact consequences can be explicitly determined to all orders in perturbation theory. If the eigenvalue condition is imposed, one can construct a theory in terms of the massless free propagator and a conformal invariant four-point vertex function only. The energy-momentum tensor of this theory is the same as that proposed by Callan, Coleman and Jackiw. (auth)

4466 (JINR-P2-6965) CONFORMAL MOMENT OF MOMENTUM. Chernikov, N. A.; Shavokhina, N. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A theoretical study of the physical quantity "the conformal moment of momentum" was made, which is intimately connected with a group of conformal representations of the space-time universe. The classical case of a relativistic particle was first approached, followed by the quantum case of a relativistic particle with a spin of ½ and a particle with zero spin. And finally the conformal moment of momentum in the quantum theory of spin and scalar fields is examined. (KSW)

4467 (JINR-P2-6968) DEFINITION OF SIMULTANEITY IN A SPECIAL THEORY OF RELATIVITY. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Possible formulation of a special theory of relativity is considered for the case when in the known formula $t_B = t_1 + \epsilon(t_2 - t_1)$, describing the moment of light signal reflection in an outlying point and defining the notion of simultaneity, ϵ is not obligatory equal to ½ but can have the value of $0 < \epsilon < 1$. The transformation formulas for coordinates, obtained in this case, have the form $x' = (x - v_1 t)[v_1/v_2 - v_1^2(c_1c_2)]^{-\frac{1}{2}}$, $t' = \{t - [v_2/(c_1c_2)]x\}[v_2/v_1 - v_2^2/(c_1c_2)]^{-\frac{1}{2}}$, where c_1 and c_2 are the velocities of light propagation and v_1 and v_2 are the velocities of the matter object motion in direct and inverse directions. Their connection with the corresponding values in an ordinary definition of simultaneity is described by the following $c_1 = c/2\epsilon$, $c_2 = c/(2 - 2\epsilon)$ and $v_1^{-1} = v^{-1} \pm (2\epsilon - 1)c^{-1}$. (auth)

4468 MELLIN TRANSFORM AND THE LIGHT-CONE STRUCTURE OF TWO-POINT AND THREE-POINT FUNCTION MATRIX ELEMENTS. Andersson, B. (Princeton Univ., NJ). Nucl. Phys.; B55: No. 1, 195-221(1973).

The behavior of functions f defined by $f(x) = \int \Delta_2^+(x, a)\, \rho(a)\, da$, is investigated in the neighborhood of the light-cone $x^2 = 0$. The quantity Δ_2^+ is the wellknown two-point distribution and the weight function ρ is a distribution of slow growth. Expressions like f in eq. (1) governs the light-cone behavior of certain matrix elements of the product of two field operators in field theories of Wightman type. Explicit formulas were given for the matrix elements between the vacuum state and the vacuum state (Kallén-Lehmann representation) as well as for the matrix elements between the vacuum state and a state with a definite non-zero (physical) energy-momentum vector. Rigorous conditions on the weight function ρ are derived to ensure that the light-cone singularities of f are of canonical type; i.e., similar to those of the distribution Δ_2^+. The usefulness of the Mellin transform of the weight function ρ is pointed out both as a computational tool as well as for a principal description of the non-canonical light-cone singularities. (auth)

4469 CONFORMAL-COVARIANT WILSON EXPANSION IN PERTURBATION THEORY. Ferrara, S.; Grillo, A. F.; Parisi, G. (CNEN, Frascati, Italy). Nucl. Phys.; B54: No. 2, 552-559 (1973).

The Wilson expansion at light-like distances is investigated in perturbation theory. Ward identities for broken conformal symmetry are used; it is found that, for any value of the physical coupling constant, the Wilson expansion is asymptotically conformal covariant provided there exists a non-trivial scale-invariant skeleton theory. (auth)

4470 OBSERVABLES AND FIELDS. Haag, R. (Univ., Hamburg). pp 1-89 of Lectures on Elementary Particles and Quantum Field Theory. Vol. II. Deser, S. (ed.). Cambridge, MA; Massachusetts Inst. of Tech. Press (1970).

Axiomatic quantum field theory in various formulations is discussed. The structure of superselection rules, charge quantum numbers, and statistics are then discussed. The physical content of a field theory model for the description of strange statistics is analyzed for the case of a parafermi field of order 2. (LBS)

4471 GNS CONSTRUCTION: A PEDAGOGICAL EXAMPLE. Reed, M. C. (Princeton Univ., NJ). pp 415-436 of Lectures on Elementary Particles and Quantum Field Theory. Vol. II. Deser, S. (ed.). Cambridge, MA; Massachusetts Inst. of Tech. Press (1970).

An example is given to show why a change of Hilbert space is often necessary in quantum field theory and how this is accomplished using the GNS construction. (LBS)

4472 EQUATIONS FOR EFFECTIVE LAGRANGIANS. Prokhorov, L. V. (Leningrad State Univ.). Yadern. Fiz.; 16: No. 4, 854-862(Oct 1972). (In Russian).

A formulation of quantum field theory in terms of effective Lagrangians only is proposed. Equations, which are self-consistent conditions, are postulated for them. The properties of these equations are discussed. Solutions for linear approximation were found in a model case of zero-dimensional space-time. (auth)

Gravitation and General Relativity

4473 (ITF-72-106-P) MOTION OF A BORN-RIGID BODY IN GENERAL RELATIVITY. Evtushenko, S. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Within general relativity it is shown that the motion of continuum of the material points which satisfy the differential conditions of a Born rigidity can be represented as the moment of a chosen point and rotation of the rest around the one singled out. (auth)

4474 T-SOLUTIONS OF EINSTEIN'S EQUATIONS. Korkina, M. P.; Gladush, V. D. (Dnepropetrovsk State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 10, 1699-1703(Oct 1972). (In Russian).

A nonstatic spherically symmetrical gravitational field is considered. All the metrical coefficients in this field are a function of time (T-field) only. The behavior of the test particles and light rays in the T-field is investigated. (auth)

4475 GRAVITATIONAL WAVES IN EINSTEIN'S THEORY. Zakharov, V. D. New York; John Wiley and Sons, Inc. (1973). 201p. $15.00.

Translation of Gravitatsionnye Volny v Teorii Tyagoteniya Einshteina by R. N. Sen.

The topics cover approximation methods for gravitational waves, the Cauchy problem for Einstein equations, gravitational waves, Pirani, Bel, Lichernowicz, and Zel-Manov criteria, and other criteria for gravitational fields and propagation of gravitational waves, plane gravitational waves defined by an absolutely parallel vector field. Also treated are the gravitational radiation field asymptotic properties, gravitational waves and chronometric invariants, and the problem of gravitational waves and physical experiment. (JFP)

4476 THERMAL NOISE AND THE DETECTION OF GRAVITY WAVES. J. Phys., E (London); 6: No. 5, 417-422(May 1973).

A simple mathematical formalism is set up to describe thermal noise. The formalism and its theorems (the Wiener–Khintchine theorem and the generalized Nyquist theorem) can be applied to almost any instrument. A four-step procedure is given to minimize the effect of thermal noise on signal detection. The ideas are shown in practice in a gravity wave detector which is described. (auth)

4477 MINIMAL AND NONMINIMAL GRAVITATIONAL INTERACTIONS, AND THE ASYMMETRIC ENERGY MOMENTUM TENSOR. Hayashi, K. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Gen. Relativity Gravitation; 4: No. 1, 1-11(Feb 1973).

Minimal and nonminimal gravitational couplings are discussed in terms of the translation gauge fields $b_k{}^\mu$, which are necessary to describe the gravitational interaction of the spin ½ field. For this purpose the extension of the conventional tetrad formalism of general relativity is carried out. The general framework contains four arbitrary parameters; one of them represents the asymmetry of the affine connection (or equivalently that of the energy-momentum tensor) and the others measure possible deviations from Einstein's gravitational Lagrangian, which will be responsible for spin effects. The physical meaning of the invariance requirement is discussed with respect to the Poincaré gauge transformation that uniquely leads, within the present framework, the Einstein's theory of gravity. (auth)

4478 POINCARE GAUGE INVARIANT SPINOR THEORY AND THE GRAVITATIONAL FIELD. 2. Duerr, H. P. (Max-Planck Institut fuer Physik and Astrophysik, Munich). Gen. Relativity Gravitation; 4: No. 1, 29-52(Feb 1973).

The nonlinear equation for an abstract noncanonical 2-component Weyl spinor field—as used with the inclusion of internal symmetries in Heisenberg's nonlinear spinor theory of elementary particles—which is invariant under scale, phase, and Poincaré transformations is modified in such a way as to become invariant under space-time dependent phase gauge and Poincaré gauge transformations. In such an equation a phase gauge field B_m, six Lorentz gauge fields $A_{[k\lambda]m}$ and four translation gauge fields $g_{\mu m}$ have to be introduced. It is demonstrated that all these fields can be identified as certain combinations of the Weyl spinor field, and hence should be considered in a rough sense as "bound states" of this spinor field. In particular the "electromagnetic field" B_m and the "gravitational field" $g_{\mu m}$ appear as S-states and P-states of a spinor-antispinor system. The noncanonical property and the operator character of the spinor field is essential for this result. The relation between the translation gauge field and the spinor field involves a fundamental length. In a classical geometrical interpretation this relation leads to Einstein's equation of gravitation without cosmological term in a Riemannian space without torsion if the fundamental length is identified with Planck's length. It is shown that this equation is covariant under the larger symmetry group of phase gauge and Poincaré gauge transformations. The modified nonlinear equation constructed solely from a single 2-component Weyl field hence seems to incorporate in an extremely compact way "electromagnetic" and "gravitational" interaction in addition to nonmass-zero interactions. In this equation no arbitrary dimensionless constants enter. The considerations can be generalized to Dirac spinor fields and to spinor fields involving additional interior degrees of freedom. (auth)

4479 CONSTRUCTION AND CHARACTERIZATION OF GRAVITATIONAL FIELDS. Kramer, D.; Neugebauer, G.; Stephani, H. Fortschr. Phys.; 20: No. 1, 1-75(1972). (In German).

The study concerns several methods for the construction and the invariant classification of exact solutions to Einstein's field equation. General mathematical principles are discussed first. Then solutions are derived for ideal liquids or electromagnetic fields which can be embedded into flat five- or six-dimensional spaces. Based on analogies from classical electrodynamics, the time-independent Einstein–Maxwell fields are treated subsequently. The method of invariant transformation is used to construct new solutions from already known ones. (HBG)

4480 RELATIVE STRENGTHS OF INERTIAL-GRAVITATIONAL FIELDS. Raigorodski, L. D. (Leningrad Shipbuilding Inst.). Phys. Lett.; 43A: No. 5, 443-444(9 Apr 1973).

The "relative" inertial-gravitational field is introduced. (auth)

4481 ONE EFFECT OF THE GENERAL THEORY OF RELATIVITY. Abdil'din, M. Vestn. Akad. Nauk Kaz. SSR; No. 6, 71(Jun 1972). (In Russian).

It is shown that not only light but also ponderable matter which moves along the axis of rotation of a massive body experiences a deflection about its own axis of rotation. (KSW)

4482 CHARGE SECTOR PROBLEM OF VACUUM VECTOR FOR THE YUKAWA$_2$ QUANTUM FIELD THEORY. Park, Y. M. (Indiana Univ., Bloomington). Nuovo Cim.; 14A: No. 3, 613-620 (1 Apr 1973).

Defining the charge density $\rho_\omega(x)$, $x \in R$, in the physical space F_{ren} for the Yukawa$_2$ model, it is shown that the charge density of the physical vacuum vector Ω_ω, $(\Omega_\omega, \rho_\omega(x)\Omega_\omega)$, is uniform over all space R. Moreover there exist(s) the physical vacuum vector(s) $\Omega_{\tilde{\omega}}$ such that $(\Omega_{\tilde{\omega}}, \rho_{\tilde{\omega}}(x)\Omega_{\tilde{\omega}}) = 0$ for any coupling constant and $x \in R$. (auth)

REACTOR TECHNOLOGY AND REGULATION

4483 UNDERWATER NUCLEAR REACTOR. Devin, B.; Dupuy, G.; Schwartz, J. P. (to Commissariat a l'Energie Atomique). French Patent 2,118,871. 4 Aug 1972. Filed date 24 Dec 1970. 15p. (In French).

An underwater nuclear reactor is presented. The core is composed of fissile material and is provided in its central part with a number of thermionic diodes. The emitter of each diode contains fissile material enabling the chain reaction to take place. The diodes are connected electrically to one another. In the peripheral part surrounding the central part of the core, a plurality of fuel elements completes the critical mass. An inert gas envelope surrounds the diodes and forms a thermal barrier between these diodes and the rest of the core. Means for cooling the core and effecting neutronic control using movable absorbent elements inside and outside the peripheral zone of the core are envisaged. (FR)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 3426, 3439, 4584–4586, 4676–4679, 4683, 4691–4698, 4711–4724, 4727–4733, 4739–4741, 4743–4751, 4755–4758, 4764–4769, 4779–4784, 4792–4795, 4810, 4818–4822, 4832, 4833, 4865–4868, 4871–4873, 4891–4894, 4902–4905, 4907, 4908, 4910, 4915–4918, 4927, 4934, and 4935.

4484 (EUR-4924) GARIGLIANO NUCLEAR POWER PLANT. Annual Report, 1971. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). Mar 1973. 104p. (In Italian). Dep. NTIS (U. S. Sales Only) $7.25. EUR FB 150,-.

Activities at the Garigliano power plant between 1 March 1971 and 29 February 1972 are reported. The gross total output of the plant during this period was about 1163 million KWh, the gross electrical energy generated between the beginning of commercial operation of the plant and 29 February totalling 7766 million KWh. During the period under consideration the Garigliano plant operated at a power of 150 MWe because of the failure of reactor recirculation pump A. From 14 May to 6 June 1971 the plant was shut down for inspection of the above recirculation pump and for scheduled maintenance work. The average core burnup on 29 February was 12,200 MWd/t of uranium; the maximum burnup of the first-load elements was 18,200 MWd/t. The maximum burnup of the first reload uranium and plutonium fuel elements was 14,700 and 14,000 MWd/t respectively, whereas that of the second reload elements was about 7200 MWd/t. The gross electrical energy generated by the Garigliano plant between 1 March 1971 and 29 February 1972 was 1,163,011,000 KWh, and the net energy was about 1,101,618,000 KWh, the average utilization factor for the period in question was about 83%. Plant availability (about 83%) was restricted by the failure of reactor recirculation pump A, which took place on 1 February 1971, as a result of which power dropped to 150 MWe. During May and June the plant was shut down; the above pump was disconnected from the circuit and a blind flange was welded onto the casing to permit operation of the plant with branch A in natural circulation. During the shutdown (14 May–6 June) some of the leaks in feedwater heater No. 2 were repaired and the main valves on the feed line overhauled. During the last 10 days of June and until 7 July plant output was reduced to 115 MW owing to a low level in the condenser due to lack of chlorination. The non-availability of the conventional section during October and November was due to difficulties in monitoring the level of secondary steam generator A. On 29 December and 30 the plant was shut down when the turboalternator cut out owing to a trip in the stator earth safety system and also on account of high vibrations in some of the turbine bearings. (auth)

4485 (FIND-50298-R1) FIND: COOPER NUCLEAR STATION. Raleigh, H. D. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 10 Apr 1973. 32p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (FS)

4486 (GEAP-13295) TRANSIENT CRITICAL HEAT FLUX: EXPERIMENTAL RESULTS. Shiralkar, B. S.; Polomik, E. E.; Lahey, R. T. Jr.; Gonzalez, J. M.; Radcliffe, D. W.; Schnebly, L. E. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Sep 1972. Contract AT(04-3)-189. 373p. Dep. NTIS $10.60.

Experimental data are presented for the Critical Heat Flux (CHF) during transient conditions of flow, power, and pressure. In particular, some of the most limiting transients possible in a Boiling Water Reactor (BWR) have been simulated. Results have been obtained in a single-rod annular test section as well as in multi-rod geometries typical of a Boiling Water Reactor. Conditions which resulted in CHF were typically more severe than those expected during hypothetical BWR-type accidents. The onset of CHF is generally well predicted with MAYU-2, using steady-state correlations in conjunction with the predicted space-time values of the system thermal-hydraulic parameters. The results show that currently used design techniques and models for prediction of heat transfer during simulated hypothetical BWR transients are conservative. (auth)

4487 (JAERI-M-4874) COMPUTER CODES ST-1 AND ST-2 FOR CALCULATION OF NEUTRON ENERGY SPECTRUM IN A FUEL-ROD CELL. Toba, M.; Naito, Y. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 48p. (In Japanese). NTIS (U. S. Sales Only).

The computer codes ST-1 and ST-2 used for calculating the energy spectrum and group constants in a fuel-rod cell are included in the JAERI BWR computer code system (BWR-ACE). Main parts of these codes are composed of two computer codes UGMG42 (MUFT) and THERMOS. ST-1 is used to calculate the neutron energy spectrum in a fuel-rod cell which contains UO_2 and PuO_2, while ST-2 is revised to calculate the spectrum in a fuel-rod cell with Gd_2O_3. The nuclear library for THERMOS code of ST-1 or ST-2, also used for the LASER code, is made from the nuclear data ENDF/B. The input and the output form, and the results of test calculations are described. (auth)

4488 (JEN-250) MANAGEMENT AND PLANNING OF FUEL ELEMENTS IN LIGHT WATER REACTORS. Velarde, G.; Aguilar, F.; Ahnert, C.; Aragones, J. M.; Bru, A.; Caro, R.; Gomez, M.; Guerra, J.; Llorente, A.; Palmero, A.; Serrano, J. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 467p. (In Spanish). Dep. NTIS (U. S. Sales Only) $25.50.

A detailed method of core analysis and in-reactor fuel management for light-water reactors is described, covering neutronics, thermal-hydraulics, kinetics and economy. A preliminary check of the method on two power reactors (BWR and PWR) is included, showing good agreement in the comparison with reactor vendor calculations and in-core measurement results. Also included is a short description of the computer programs involved. (auth)

4489 (WASH-1203-72) OPERATING HISTORY OF U. S. NUCLEAR POWER REACTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 1972. 71p. Dep. GPO $.90.

The operating history of U. S. nuclear power plants through December 31, 1972 is highlighted. Included are those nuclear reactor facilities which produce electricity, even if in token amounts, or which are part of a development program concerned with the generation of electricity through the use of a nuclear reactor as a heat source. The information presented is based on data furnished by facility operators. Data on units that operated in prior years but have since been shutdown and power reactor systems intended for propulsion or auxiliary space power applications are not included. The charts are plotted in terms of cumulative thermal energy as a function of time. Since only those shutdowns of five days or more are shown, the charts do not give a detailed history of plant operation. They do, however, give an overview of the operating history of a variety of developmental and experimental nuclear power reactors. The data presented in the tables shows the yearly gross generation of electricity for each U. S. nuclear plant and, for civilian power plants, information on reactor availability and plant capacity factor. (auth)

4490 FLUID TO FLUID MODELING OF CRITICAL HEAT FLUX. A Compensated Distortion Model. Ahmad, S. Y. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Int. J. Heat Mass Transfer; 16: No. 3, 641-662(Mar 1973).

Modeling is of practical importance in reducing the high cost of critical heat flux testing for boiling water power reactors. A method widely used is to replace water by a modeling fluid having a lower latent heat of vaporization. A generalized technique for such fluid modeling of critical heat flux is developed from classical dimensional analysis and theory of models. The problem of multiple distortion is solved by introducing a modeling parameter which is a function of Weber number and liquid and vapor superficial Reynolds numbers. The technique of compensated distortion is employed in the development of the modeling

parameter. The resulting model has been tested at different liquid/vapor density ratios for various Freon compounds, water, potassium, and carbon dioxide, over a large range of mass flux and inlet sub-cooling, and in both the subcooled and quality regions. Excellent agreement is shown between experimental data and the modeling technique for circular, annular, and rod bundle geometries. (auth)

4491 465 MW TURBINE FOR SHIMANE NUCLEAR POWER STATION. Nishimura, M.; Yasumoto, A. (Hitachi Ltd., Ibaraki, Japan). Hitachi Hyoron; 54: No. 9, 824-827(Sep 1972). (In Japanese).

This turbine was completed in June 1972, at Hitachi Works, Hitachi, Ltd., as one of large nuclear turbines in Japan. Presently it is being installed at the Shimane Nuclear Power Station of Chugoku Electric Power Company. In this nuclear turbine, countermeasures against drain erosion peculiar to the nuclear turbines are applied to turbine rotors, buckets, casings and diaphragms. In order to remove moisture, grooved buckets are used, and moisture separators are installed. Modified 38-inch last stage buckets are used in order to allow 58.5 Hz off cycle operation. Basic philosophy for the design of governing system comprising pressure regulators and bypassing systems is explained. Special feature of the nuclear turbine of boiling water reactor type is that a system for controlling pressure of main steam at constant is installed as well as control of turbine speed. This turbine controller is a mechanical hydraulic governor which is composed of hydraulic machinery and lever mechanism, and in addition, one of two pressure control loops employs an electro-hydraulic pressure regulator which has faster response and precise controllability. (JA)

4492 MATERIAL AND CONSTRUCTION PROBLEMS OF NUCLEAR POWER PLANTS WITH LIGHT WATER REACTORS. Zielinski, J. L. (Politechnika, Warsaw); Ablewicz, Z.; Jozwik, B. Inz. Budownictwo; 29: No. 34, 206-213(1972). (In Polish).

General information is given about the technology of nuclear power plants (and their main equipment) with reactors cooled and moderated by light water. Some solutions to reactor housing with descriptions of special construction problems and specific building works are presented. (auth)

4493 INVESTIGATION OF THE FUEL LOADING PATTERN ON THE CORE BURNUP BY FLARE SIMULATION. Motoda, H. (Hitachi, Ltd., Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 12, 751-753(Dec 1972).

The three-region optimal principle and the FLARE code were used to study the effect of differences in fuel loading patterns on the core burnup in a 1352 MW(t) BWR power reactor. (auth)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 3442, 4488, 4489, 4492, 4580–4583, 4591–4593, 4606, 4610, 4652, 4669–4675, 4684–4690, 4702–4710, 4725–4728, 4733–4738, 4742, 4752–4754, 4759–4763, 4772–4778, 4785–4791, 4796–4809, 4811–4817, 4823–4831, 4834–4864, 4869, 4870, 4874–4890, 4895–4901, 4906, 4909, 4911–4914, 4919–4926, 4928–4933, 4936, and 4937.

4494 (BMFT-FBK-73-3) FLOW MEASUREMENTS IN THE LOWER PLENUM OF A PWR VESSEL. Weber, E.; Dittrich, W. (Siemens A.G., Erlangen (West Germany)). Mar 1973. 64p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

Since the shape of the lower plenum and the support structure influence the velocity distribution of the core entry, the optimum design for the core support structure was sought. An air model of a four-loop-reactor was used to measure the flow pattern. Then the number and position of the plates of the core support structure were varied. The distance between the bottom of the plenum and the lowest plate is important and must be smaller than the width of the jet produced by an annulus. A slight swirl or cylindrical screen have an equalizing effect. (FS)

4495 (CEA-CONF-2219) CORROSION PRODUCT ACTIVITY IN THE PRIMARY COOLANT WATER OF THE CHOOZ REACTOR. Frejaville, G.; Lott, M.; Marchal, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 15p. (In French). (CONF-721018-14). Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

Concentration and activity measurements of corrosion products in the primary coolant circuit of the Chooz reactor during steady runs (^{58}Co, ^{60}Co, and ^{54}Mn) and after shutdown (^{58}Co, ^{60}Co, ^{54}Mn, and ^{59}Fe) enabled the quantities of material detached from the metallic structures (0.8 mg dm^{-2} $month^{-1}$), the core half-life deposition time ($T_{\frac{1}{2}}$ = 10 minutes) and the corresponding out of core time ($T_{\frac{1}{2}}$ = 2 hours) to be estimated. These measurements demonstrate the very large increase in the activity of the coolant (approximately 1000) following a shutdown and subsequent drop in temperature to 100°C. (FR)

4496 (CEA-CONF-2220) SURVEILLANCE OF THE EMBRITTLEMENT OF A PRESSURIZED WATER REACTOR VESSEL. Devillers, C.; Dupont, C. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 9p. (In French). (CONF-721018-13). Dep. NTIS (U. S. Sales Only) $3.00.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The methods used within the framework of the reactor pressure vessel surveillance program to evaluate the embrittlement due to neutron irradiation throughout the life of the reactor are presented. A method is proposed for directly estimating the fast neutron fluence at the internal wall of the reactor vessel using a heat flux integrator on the outer wall of the vessel. The method also provides information about the radiation dose. (FR)

4497 (WCAP-3385-34) SAXTON PLUTONIUM PROJECT QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING DECEMBER 31, 1972. Goodspeed, R. C. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Mar 1973. Contract AT(11-1)-3044. 43p. Dep. NTIS $4.25.

Data from the destructive and nondestructive examinations of fuel rods from Core III in the Saxton Reactor are presented. (JWR)

4498 GAS-INSULATED, LIQUID-COOLED NUCLEAR REACTOR. Kraemer, W.; Loevgren, A. S. (to Aktiebolaget Atomenergi). Canadian Patent 912,714. 17 Oct 1972. Priority date 21 May 1968, Sweden.

A prestressed concrete pressure vessel for a boiling-water reactor with a steel liner and a steel inner containing vessel is described. The containing vessel is open at the bottom. Between the two steel vessels, a gas-filled gap provides thermal insulation for the concrete. At the bottom, between the water-filled interior of the reactor and the insulating gas-filled gap, there is a double water-lock. Variants with more gaps and water-locks are possible. The invention simplifies maintenance. (CA)

4499 FINNISH NUCLEAR POWER PLANT LOVIISA. Arch. Energiewirt.; 26: No. 11, 507-512(1972). (In German).

The Loviisa reactor is briefly described. Information is included on the: reactor site, reactor, reactor building, and primary coolant system. The most important technical data are tabulated. (GF)

Power Reactors, Non-Breeding, Graphite Moderated

Refer also to abstracts 3195, 3364, 3388, 4573, 4596, 4698–4701, 4770, and 4771.

4500 (CEA-CONF-2213) COMPUTATIONAL METHODS FOR GRAPHITE GAS COOLED REACTORS SHIELDING: COMPARISON WITH SHIELDING MEASUREMENTS MADE DURING START-UP TESTS. Brisbois, J.; Duco, J.; Bourdeau, F.; Chapus, J. (Commissariat a l'Energie Atomique, Paris (France); Electricite de France, Paris). [nd]. 33p. (In French). (CONF-721018-10). Dep. NTIS (U. S. Sales Only) $3.75.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

The principal shielding problem of gas cooled graphite reactors (particularly those provided with integrated exchangers) is related to the accessibility of the primary system after shutdown for inspection or repairs to the internal structure. Essentially, the problem occurs at two positions: above the heat exchanger, which is protected from direct radiation by a shield in the core supporting structure; at the lower end of the peripheral gap provided for the flow of cold gas, this gap acting as a privileged path for neutrons from the reactor core. The methods of calculation developed are described together with their fitting to mock-ups. Comparisons are then made between the shielding measurement results obtained for Saint-Laurent-I, Saint-Laurent-II, and the Bugey power plants during their start-ups and the theoretical predictions. (FR)

4501 (CEA-CONF-2214) CALCULATION OF THE ACTIVITY IN AN H.T.R. REACTOR. Brisbois, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972.

31p. (In French). (CONF-721018-24). Dep. NTIS (U. S. Sales Only) $3.75.

From 4th international conference on reactor shielding; Paris, France (9 Oct 1972).

In HTGR reactors, the activity of the circuits and particularly of the heat exchanger is essentially due to metallic fission products having escaped from the fuel because of coating defects (manufacturing defects or irradiation damage). If the number of particles damaged is known, the activity of the fission products in the circuits can be calculated. The calculation is made in two stages: migration of the fission products through the graphite parts of the fuel; migration of the fission products in the circuit. A model enabling these problems to be resolved was developed from a study of the resulting physical phenomena. An application to a 3000 MW(t) reactor is given as an example. (FR)

4502 (DP-Report-639) NEW METHODS FOR THE INVESTIGATION OF RADIOISOTOPE TRANSPORT IN A GAS COOLED REACTOR. Dragon Project. Rowland, P. R. (Atomic Energy Establishment, Winfrith (England)). Mar 1969. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

The evaluation of theories for the transport of fission products and activation products requires data to be obtained in a well-defined manner. Work is described in which this object is achieved by an electrolytic technique (the "electroleech") which is used to sample plated-out isotopes on the coolant circuit surfaces of the Dragon Reactor. Further information is obtained by using a strigil technique to separate the layers, (e.g., dust, oxide film) present on the metal surfaces. Application of these methods and their relevance to interpretation is illustrated by the examination of typical parts of the coolant circuit (a coolant duct and a primary heat exchanger) in the Dragon HTR. The most important conclusions drawn are: (i) that the main part of the activities due to ^{137}Cs and ^{90}Sr occurs in the oxide films on the metals, (ii) that at elevated temperatures there is an increase in the amounts of ^{90}Sr and ^{51}Cr dissolved in the oxide on stainless steel, and (iii) that there is mobility between the dust and metal oxide layers even for relatively non-volatile isotopes such as ^{90}Sr, so that the dust may play an important part in isotope transport. It is further suggested that the prediction of circuit activities would be assisted by activation analysis of samples of all carbon to be introduced into a reactor. Preliminary figures for the release of Cs and Sr from the High Temperature Experiment in the Dragon Reactor are given. (auth)

4503 (DP-Report-659) DIMENSIONAL AND PHYSICAL PROPERTY CHANGES OF GRAPHITE SPECIMENS IRRADIATED IN DRAGON FUEL ELEMENT 701. Dragon Project. Manzel, R. (Atomic Energy Establishment, Winfrith (England)). Oct 1969. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

Fuel Element 701 is the second of four elements in the First Metallurgical Series. It was removed from the Dragon core on 10th January, 1968 having received a maximum fast neutron dose of $\sim 9.8 \times 10^{20}$ n cm^{-2} (Ni-Dragon). Graphite specimens were irradiated in the spines of the outer rods of this element covering a temperature range of 850°C to 1230°C. The changes in dimensions and physical properties of the graphite specimens were measured and correlated to irradiation temperature and fast neutron dose. (auth)

4504 (JUL-918-RG) ANALOGUE COMPUTER STUDIES OF THE CONTROL DYNAMICS OF A 600 MW(e) HTR HELIUM TURBINE SYSTEM. Part 1. Description of the Considered Power Plant Concept and the Computation Model Applied. Hewing, G.; Dean, J. R. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Jan 1973. 121p. (In German). Dep. NTIS (U. S. Sales Only) $8.25.

An analogue computation model is described which is appropriate for studying the transient behavior of closed-cycle HTR gas-turbine plants during power changes. This computation model was used to study a non-integrated HTR helium-turbine system of 600 MW(e), the concept and lay-out data of which are also discussed. (auth)

4505 (ORNL-TM-3939) MSR COMPONENT REPLACEMENTS USING REMOTE CUTTING AND WELDING TECHNIQUES. Holz, P. P. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 62p. Dep. NTIS $5.50.

Details are described for performing remote maintenance within the severe in-cell radiation and temperature environments of the MSR. Current status of the technology required to perform each remote maintenance task is discussed, with special emphasis on functions needed, cutting, welding and positioning device development. (FS)

4506 CHARGE/DISCHARGE ARRANGEMENTS FOR NUCLEAR REACTOR. Pugh, J. (to United Kingdom Atomic Energy Authority). U. S. Patent 3,711,369. 16 Jan 1973. Filed date 23 Dec 1969. 8p.

A gas cooled nuclear reactor has its core composed of columns of blocks of moderator material which incorporate the nuclear fuel; fuel and moderator being recharged as a unit. According to this arrangement there are a number of longitudinal plugs which are located between adjacent groups of columns which fix the inter-column clearance during core operation so as to ensure a stable assembly. For refueling one of the plugs is withdrawn and an adjacent block may then be removed but a keeper is inserted to hold back blocks neighboring the void so created, and to keep other blocks from being displaced into the void. The keeper may either be a part of the charge machinery or a separate component. (Official Gazette)

4507 FUEL BLOCK FOR HIGH TEMPERATURE NUCLEAR REACTORS. Patarin, L. (to Commissariat a l'Energie Atomique). French Patent 2,113,802. 30 Jun 1972. Filed date 17 Nov 1970. 8p. (In French).

A fuel block for a high temperature nuclear reactor is presented. The moderator structure is provided with cooling channels and cavities which are blocked at both ends, containing the agglomerated fuels. The agglomerated fuels are in the form of thin plates (approximately 1 cm thick). Different types of sub-assembly are envisaged. The agglomerated sleeveless fuels can be positioned directly in the cavities of the moderator structure or grouped to form cartridges dispersed in special channels provided in the block. Agglomerates enclosed by an incorporated sleeve or an independent sleeve made of graphite can be criss-cross or radially distributed in the moderator block. The configurations presented enable the agglomerates to be efficiently cooled and an improved neutron heterogeneity to be obtained. Interactions between sleeves and fuels due to deformations are avoided. (FR)

4508 NUCLEAR POWER PLANT. Chermanne, J. M. (to Societe Belge pour l'Industrie Nucleaire). Belgian Patent 785,098. 19 Jun 1972. 6p. (In French).

A nuclear power plant comprising a gas-cooled nuclear reactor in a prestressed concrete vessel is characterized by the fact that the core of the reactor rests on a support and is traversed by an ascending current of gas at high pressure and in which the assembly of the cooling loop and the turbo-compressor block are enclosed in chambers provided in the vessel and which are accessible only by passage through a double barrier. (tr-auth)

4509 SUB-ASSEMBLY FOR A HIGH TEMPERATURE REACTOR CORE. Patarin, L.; Vivien, J. (to Commissariat a l'Energie Atomique). French Patent 2,122,299. 1 Sep 1972. Filed date 19 Jan 1971. 5p. (In French).

A high temperature nuclear reactor core sub-assembly is presented. The moderator block is provided with channels for the passage of the coolant, and channels which contain the fuel which is in the form of annular pellets. These pellets, which may be in the form of an agglomeration of uranium oxide particles, are stacked directly in the channels without any outer sleeving. The channels are blocked at their ends with annular graphite plugs. The annular fuel pellets are, however, provided with an internal sleeving through which the coolant gas circulates. This sleeving is made from the graphite obtained from the block when the fuel channels are drilled. (FR)

4510 MOLTEN-SALT REACTORS. Concepts and Technology. Haubenreich, P. N. (Oak Ridge National Lab., Tenn.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 145-152(Apr 1973).

The origins of molten-salt reactors and the highlights of their development are outlined. Principal features, including a flow diagram, are presented for the MSBR, a high-temperature thermal neutron breeder reactor operating on a Th-^{233}U cycle. The processing plant for removal of uranium, protactinium, and fission products from the circulating fuel salt is illustrated. A brief summary is given of the status of technology in reactor physics, chemistry, materials, and fuel reprocessing. Some of the problems to be resolved in relation to steam generation, maintenance, and safety are discussed. Areas of greatest uncertainty are tritium containment and cracking of Hastelloy N by fission product Te. Attractive features are breeding performance, power costs, and safety characteristics. (UK)

4511 DETERMINATION OF RATING DISTRIBUTIONS FROM GAMMA SCANNING MEASUREMENTS. Dawson, J. T. (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 167-174(Apr 1973).

Gamma scanning measurements on irradiated fuel after discharge enable the distributions of selected fission products to be determined. A method is described in which the discharge concentrations of these fission products are combined to give information on rating distributions within fuel channels of civil AGRs. (auth)

4512 DRY DENSITY OF CONCRETE AT ELEVATED TEMPERATURE. Karasuda, S.; Hoshino, I. (Shimizu Construction Co., Ltd., Tokyo). pp 931-956 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Results are given of dry density tests on concrete for the biological shield wall of the nuclear power station which was built in Tokai, Japan. The dry density was measured by several hundred specimens molded in 15-cm cubes at the construction site. The specimens were dried to constant weight at a temperature of 80 ± 5°C in ovens after 28 days curing in water. Results show a linear correlation between wet density and dry density on which dry density can be predicted with a certain confidence limit. The variation of density is mainly caused by the variation of amount of coarse aggregate in specimens. Water content of hardened concrete at elevated temperature is discussed. (auth)

4513 TESTING OF A PERFORATED PRESTRESSED CONCRETE PRESSURE VESSEL TOP SLAB MODEL. Meerwald, K.; Schwiers, G. (Brown Boveri/Krupp, Reaktorbau GmbH, Mannheim, Ger.). pp 1513-1528 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A report on an experiment on a 1:20 scale model of a perforated slab is presented. The slab is a scale model of the top slab of a concrete pressure vessel designed for the THTR-300 nuclear power plant to be constructed near Hamm/Westfalen in Germany. The results showed in comparison with tests on a non-perforated slab that the opening has no negative influence on the behavior of the top slab up to the occurrence of cracks. It is believed that this behavior could be a doweling effect of the shutter tubes. (auth)

4514 APPARATUS, INSTRUMENTATION, AND CONCRETE MODELS OF BUGEY I PRESTRESSED CONCRETE PRESSURE VESSEL. Launay, P. (Compagnie Industrialle le Travaux, Paris). pp 1529-1566 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

The design, construction, pressure and temperature testing of two $\frac{1}{3}$th models of a prestressed concrete pressure vessel built and tested in 1965/1966 at Chinon, are described to demonstrate the feasibility of the BUGEY-I P.C.P.V. operating under a pressure of 45 atmospheres, with a flat top cap including 950 penetrations and without transverse tendons. The first model was tested to failure under pressure only. The second one was submitted to a wide range of tests: pressure with sustained temperature, pressure cycles, temperature cycles, vibration. The upper standpipe unit was specially tested under high temperature. An ultimate pressure test was carried out under a 100°C thermal gradient. The instrumentation is described and an idea given of the first measurements made on the nearly completed BUGEY-I vessel itself during and after the transfer of the prestressing forces. (auth)

4515 STRAIN BEHAVIOR OF THE OLDBURY CONCRETE PRESSURE VESSEL UNDER OPERATING PRESSURE AND TEMPERATURE. Carmichael, G. D. T. (Berkeley Nuclear Labs., Eng.); Hornby, I. W.; Irving, J. pp 1567-1584 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Reactor 1 of the Oldbury Nuclear Power Station has been on load since October 1967 and during this time the strain gages installed in the pressure vessel have been monitored. Readings indicate the creep behavior of the vessel under prestress and pressure loads at the operating temperature cross falls. The changes in stress and strain due to creep under prestress and operational loading have been calculated using an iterative time-step technique allied with a finite element method of elastic analysis. The theoretical results obtained are compared with the strains measured. 13 references. (auth)

Power Reactors, Non-Breeding, Otherwise Moderated

Refer also to abstracts 2788, 3399, and 4658.

4516 (AECL-4357) RECENT PROGRESS WITH CANADA'S NUCLEAR GENERATING STATIONS. Smith, K. L. (Atomic Energy of Canada Ltd., Sheridan Park (Ontario)). Jan 1973. 31p. (CONF-720988-1). Dep. NTIS (U. S. Sales Only) $3.75. AECL $1.00.

From Canadian Electrical Association conference; Calgary, Alberta, Canada (20 Sep 1972).

The Canadian Nuclear Power Program is seeing a rapid increase in operating units. Over 2000 MW(e) of electrical output has been or will be placed on-line during 1971 and 1972. Experience with the three operating units at Pickering has been very good. Gentilly experienced birth pangs, but is now at full power. The stations in India and Pakistan are in their final stages of commissioning. (auth)

4517 (BARC/I-171) VAPOUR SUPPRESSION POOL EXPERIMENTS (PHASE I). Kakodkar, A.; Mehra, V. K. (BHABHA Atomic Research Centre, Bombay (India)). 1972. 14p. INIS.

Mockup experiments have been carried out to establish the condensation efficiency of the vapour suppression system to be incorporated in the Madras Atomic Power Plant, India. The advantages of this system over the dousing tank system have been enumerated. The experiments have been conducted in two phases: to determine the condensation efficiency and the effect of air-steam ratio and depth of submergence of downcomer on condensation, and to make a model to study the consequences of the maximum credible accident. The experimental set-up and procedure adopted are described. The calculation of the air-stream ratio and the velocities of flow show that there is complete condensation in the suppression pool, within the limitations of the experiment and that the air-steam ratio value varies during the course of the experiment. (INIS)

4518 IMPROVEMENTS RELATING TO NUCLEAR REACTOR INSTALLATIONS. Worley, N. G. (to Babcock and Wilcox Ltd.). British Patent 1,297,951. 29 Nov 1972. Filed date 14 Apr 1969. 4p.

Reference is made to power reactor installations in which fluid is utilized to absorb heat from the core and to heat heat exchangers in which vapor for driving turbines is generated and superheated. It is necessary in such installations to make provision for a situation in which there is a sudden loss of load on the electric generators, or other apparatus driven by the turbine, requiring an emergency shut-down and also to take care of reactor decay heat. A second heat exchanger is provided by means of which fluid is heated flowing in a circuit that effects reheat between two stages of a turbine, and wherein means are provided whereby the second heat exchanger may alternatively be included in a second circuit containing means whereby its heat is dissipated elsewhere than in the turbine. The fluid heated by the second heat exchanger may be water or molten Na. Heat dissipation may be effected by a heat exchanger through which a cooling medium flows. Circuit arrangements are described. (UK)

4519 EXPERIMENTAL STUDY FOR THE PRACTICAL USE OF RARE-GAS HOLD-UP SYSTEM. Nakai, S. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Doryokuro Giho; No. 3, 25-34(Feb 1972). (In Japanese).

A $\frac{1}{3}$ size test plant of 6Nm^3/hr was constructed to study problems of rare-gas retention systems for FUGEN (Japanese prototype advanced thermal reactor). Results of fundamental studies on charcoal adsorption are summarized. By using ^{85}Kr and ^{133}Xe as tracers, the adsorption and retention time of various activated charcoal filters were studied with varying fundamental factors such as quantity, dimension and temperature of the charcoal, and flow rate and pressure of input air. An outline of the test plant, along with methods and results of the experiments, are summarized together with future problems. Agreement between calculated and experimental values of the retention time was excellent. (JA)

4520 NUCLEAR REACTOR. Geist, J. J. (to EURATOM). Belgian Patent 721, 815. 2 Oct 1968. Priority date 25 Oct 1967, Federal Republic of Germany (F. R. Germany).

The invention has as its object a nuclear reactor whose core consists of numerous channels for a liquid fuel and numerous channels for a coolant the circulation of which is forced. The reactor is characterized by the fact that the fuel channels are divided into groups of at least two of which the heat transfer coefficients are very different and which are connected on the edges of the core by short connecting channels to form closed circuits without a pump. (BE)

4521 PRESSURE-TUBE WATER REACTORS, AN ALTERNATIVE FOR FUTURE. Nandet, R. (CEA, Paris). At. Jap.; 16: No. 6, Suppl., 63-67(Jun 1972). (CONF-720341-8).

From 5th Annual Conference of the Japan Atomic Industrial Forum; Tokyo, Japan (22 Mar 1972).

A number of interesting features of pressure-tube reactors are

described from the standpoints of construction, safety, and operation. Secondly, the concept of heavy water moderated boiling water cooled reactors, which is the case of Fugen reactor, is described in some detail, including problems of positive void coefficient. From experience in EL4, it can be said that use of the heavy water, which is confined, cool and without pressure, does not involve particular troubles in tritium hazards, loss, and down-grading. Advantages of on-power refuelling, with fuel handling machines under reactors as in the Gentilly or Fugen reactors, are also explained from the viewpoints of fuel cost, form factor and reactor availability. Finally, the fuel cost for this type of reactor is estimated to be around 1.1 mills/kWh, instead of 1.7 to 1.9 mills/kWh in present water reactors. The advantage in fuel cycle cost is also discussed from the viewpoints of plutonium recycling and availability of natural uranium. (JA)

4522 BEHAVIOUR OF LENGTHENING PSGHWR FUEL PINS SUBJECTED TO AXIAL CONSTRAINTS DURING NORMAL OPERATION. Anderson, R. G. (United Kingdom Atomic Energy Authority, Salwick, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 193-197(Apr 1973).

A summary is presented of theoretical work carried out to show that significant lengthening of a fuel pin in the prototype steam generating heavy water reactor can be tolerated during normal operation after the leading pin touches the bottom end grid. The conclusions support proposals aimed at allowing "overgrow" beyond first touch-down and suggest that the process may be monitored by pond measurements. The results may be of interest in other reactor systems. (auth)

4523 ASSESSMENT OF SYSTEM RESPONSE CHARACTERISTICS FROM NOISE MEASUREMENTS AT A SINGLE POINT WITH PARTICULAR APPLICATION TO FLOW STABILITY. Gall, C. J. (United Kingdom Atomic Energy Authority, Winfrith, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 175-181 (Apr 1973).

A method is established for determining response characteristics of a general system from measurements of random variations ("noise") of a single variable while operating in nominally steady conditions. The method was used to determine the hydrodynamic response characteristics of a Winfrith SGHWR channel as a function of channel power, and extrapolation gave an estimate of the instability threshold power. The channel response was calculated using a nuclear kinetics/hydrodynamic computer code which gave good agreement with the measurements. An estimate is made of likely error levels in the use of the code. A measurement of noise variance as a function of operating level can also be used to determine system stability. (auth)

4524 ANALYSIS OF PRESTRESSED CONCRETE PRESSURE VESSELS FOR NUCLEAR REACTORS IN CZECHOSLOVAKIA. David, M. (Energoprojekt, Prague). pp 203-219 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

The methods of theoretical stress analysis applied to prestressed concrete reactor vessels are examined. Both elastic stress analysis and finite element analysis are discussed. (auth)

4525 APPLICATIONS OF HEAVY CONCRETE IN CANADA. Smith, E. C. (Atomic Energy of Canada Ltd., Sheridan Park, Ont.). pp 1177-1193 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A brief commentary on the Canadian experience in development and application of heavy concretes for reactors (Gentilly, Pickering, etc.) and certain opinions on the value of concrete for nuclear reactors are presented. (auth)

4526 DESIGN FEATURES AND CONCRETE REQUIREMENTS FOR A VACUUM BUILDING AT THE PICKERING NUCLEAR GENERATING STATION. Paul, R. C.; Watt, D. G.; Haines, N. S.; Havard, D. G. (Hydro-Electric Power Commission of Ontario, Toronto). pp 1321-1352 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A summary of the design research, construction, and structural performance of the Pickering Generating Station near Toronto, Ontario is presented. (auth)

Power Reactors, Breeding

Refer also to abstracts 4510, 4597, 4603, 4648, 4649, 4651, 4654, and 4680–4682.

4527 (AI-AEC-13038) HAA-3 USER REPORT. Hubner, R. S.; Vaughan, E. U.; Baurmash, L. (Atomics International, Canoga Park, Calif.). 30 Mar 1973. Contract AT(04-3)-824. 108p. Dep. NTIS $3.00.

The Heterogeneous Aerosol Agglomeration–Version 3 (HAA-3) computer program which has been validated by comparison with existing experimental data and which can be used to establish the capability of containment-related design features of LMFBR structures is described. A detailed justification of the model and its application are described. (auth)

4528 (ANL-7957) SODIUM TECHNOLOGY QUARTERLY REPORT, APRIL–JUNE 1972. Kesser, G. M. (comp. and ed.). (Argonne National Lab., Ill.). Nov 1972. Contract W-31-109-eng-38. 72p. Dep. NTIS.

The research, development, and management efforts of Argonne National Laboratory's Sodium Technology Program for the period April–June 1972 comprised activities in the following areas: (1) Design work has been started on a multipurpose sampler for use at FFTF; the sampler will provide the capability for obtaining overflow sodium samples, filtering flowing sodium for assay of particulates, and equilibrating metal specimens. (2) In the analytical standards program, efforts were continued on the preparation of RDT standards on specifications for measuring and controlling the purity of sodium and cover gas and on laboratory work related to the methods to be used for purity measurement, with emphasis on equilibration methods for determining the activities of carbon, oxygen, and hydrogen in sodium. (3) Performance-characterization tests of an improved electrochemical oxygen meter having a thoria-yttria electrolyte and a gas reference electrode have been completed; other work on meters has included testing of on-line monitors for hydrogen and leak detectors for steam generators, and testing of meter modules. (4) Work was continued on the design and fabrication of a cover-gas analysis system for separating ^{23}Ne from noble-gas fission products in cover gas; testing of a laboratory prototype of a system for monitoring the ^{135}I content of reactor primary sodium was begun; and development work was continued on an on-line diffusion meter for monitoring tritium in sodium. (5) Studies of the chemistry of liquid sodium have been directed toward evaluation of vacuum distillation as a means of determining nonmetallic impurities in sodium and investigations of oxygen-hydrogen interactions in sodium. (6) Work has continued on the program to determine the integrated effects of fast-neutron and sodium environments on the properties of stainless steel and to develop postexposure testing methods for the stainless steel specimens; in the study of carbon transfer in sodium-steel systems, a mathematical model is being developed for predicting the magnitude and rate of carbon migration in reactor sodium systems. (auth)

4529 (ANL-7986) ANALYSES OF EBR-II CORE-COMPONENT DEFORMATIONS. Bump, T. R.; Huebotter, P. R.; Phipps, R. D.; Strain, R. V. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-Eng-38. 53p. AT $5.45.

The analyses of deformations in core components discharged from the EBR-II are described. Four types of deformations are considered: (1) residual wrapper-tube bow, (2) moat formation near wrapper-tube spacer pads, (3) residual fuel-element bow, and (4) wrapper-tube rounding from internal pressure. These deformations result from fast-neutron-induced swelling and creep, and their analyses test the reliability of existing swelling and creep correlations as well as analytical methods. This reliability is shown to be unsatisfactory; much still remains to be learned about fast-reactor core-component behavior. (auth)

4530 (ANL-RDP-12) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, DECEMBER 1972. (Argonne National Lab., Ill.). 1 Feb 1973. Contract W-31-109-eng-38. 186p. AT $7.60.

Highlights of project activities for December 1972 are presented. These include dosimetry and fission gas measurements for EBR-II, instrumentation and control development, sodium technology, LMFBR fuels and materials development, LMFBR physics measurements, and LMFBR safety studies. (JWR)

4531 (ANL-RDP-14) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUARY 1973. (Argonne National Lab., Ill.). 22 Mar 1973. Contract W-31-109-eng-38. 189p. AT $7.60.

Research progress during February 1973 is reported. Chapters are included on EBR-II operations, LMFBR design support, instrumentation and control, sodium technology, fuels and materials development, fuel cycle, reactor physics, reactor safety, and environmental studies. (JWR)

4532 (CEA-CONF-2099) PHENIX: PROTOTYPE FAST-REACTOR POWER PLANT. Megy, J.; Guillemard, B.; Robert, E., Cratte, J. P.; Labat, P. (Commissariat a l'Energie Atomique,

Saclay (France). Centre d'Etudes Nucleaires). 1972. 22p. (In French). (CONF-721062-2). Dep. NTIS (U. S. Sales Only).

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

The main features of PHENIX, which was developed to demonstrate the use of fast reactors in power plants, are described. The difficulties met in the reactor design and the solutions used to overcome these difficulties are discussed. (FS)

4533 (COO-2245-2) COOLANT MIXING IN LMFBR ROD BUNDLES. Quarterly Progress Report, December 1, 1972-February 28, 1973. Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). 7 Mar 1973. Contract AT(11-1)-2245. 14p. AT $4.00.

Progress is reported on the development of analytical models and measuring equipment and methods for studying coolant mixing in LMFBR channels and in assessing available hydraulic test data on such mixing. (LCL)

4534 (EURFNR-1066) DESIGN, IRRADIATION, AND POST IRRADIATION EXAMINATION OF THE UO_2/PuO_2 FUEL PIN BUNDLE MOL-7A. Kummerer, K.; Geithoff, D.; Weimar, P. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 192p. (KFK-1522). Dep. NTIS $11.75.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The irradiation experiment Mol-7A comprises the irradiation of a fuel pin bundle with 7 stainless steel clad PuO_2-UO_2 pins in the epithermal neutron flux of the Belgian reactor Br 2. The design of the pins with respect to material composition and geometry as well as the operational conditions are highly representative for the conditions in a fast breeder prototype like the SNR 300. Having a PuO_2-content of 20 w/o, the smeared density of the fuel was 80% of theoretical density. The claddings which consisted of 3 quite similar types of high temperature resistant stainless steels had a 0.38 mm wall thickness. The pin diameter was 6.0 mm. As far as the pin length is concerned, the simulation of true fast reactor conditions was not possible due to the limited irradiation space in the BR 2. The ratio between fuel volume and fission gas plenum, however, is representative for a fast reactor pin. The operational conditions during irradiation were designed to be 500 watts/cm for the pin rating and 630°C for the maximum cladding temperature. In the course of the experiment the power happened to be remarkably higher, up to about 590 watts/cm. The target burnup was 60000 megawatt days/t M, but only about 45000 MWd/t were reached, when the experiment had to be terminated due to a pin failure. Data and facts on the experimental objectives, pin design, specifications for pin and bundle, fabrication of the pins including preirradiational tests, the irradiation history, and, finally, the destructive and nondestructive post irradiation examination are compiled. The cause for the pin failure in the bundle could not be identified. Primarily a fault in material components or pin fabrication is suspected. But also the non-scheduled overpower during irradiation might have initiated the damage. (auth)

4535 (EURFNR-1068) VELOCITY AND TEMPERATURE FIELDS IN FUEL ROD BUNDLES OF SYMMETRICAL AND ASYMMETRICAL GEOMETRY. Hofmann, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan 1973. 89p. (KFK-1653). Dep. NTIS $5.45.

Work performed under United States-Euratom Fast Reactor Exchange Program.

A theoretical analysis is presented to determine the turbulent velocity and temperature fields in asymmetrical bundle geometries. For the coolant the velocities and temperatures are calculated in azimuthal and axial directions under hydrodynamic but not thermal conditions. This is coupled with a 3-dimensional determination of the temperature distribution in the fuel and the cladding. Mixing of the coolant is taken into account by appropriate equations for the diffusivities of momentum and energy. The physical properties are temperature and pressure. The method is compared with experimental results. The analysis is applied to the sodium cooled fast breeder reactor SNR. For this example the effects of different rod displacements upon the velocity and temperature fields in the coolant and the cladding and fuel are discussed. (auth)

4536 (EURFNR-1070) MECHANICAL BEHAVIOR ANALYSIS OF SUBASSEMBLY BOXES SUBJECT TO MATERIAL CREEP AND SWELLING. Liebe, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 77p. (KFK-1724). Dep. NTIS $5.45.

Work performed under United States-Euratom Fast Reactor Exchange Program.

Thermal bowing as well as irradiation induced material creep and swelling determine the mechanical performance of fast breeder reactor subassemblies. Therefore the safe and economic core design requires suitable analytical methods. In particular the plane bending problem of a single subassembly box is treated and a simple incremental method is described allowing the calculation of the time dependent stresses, forces and deflections due to thermal, creep and swelling strains. The method is based on the beam theory. Usual matrix methods of elastomechanics are employed to find the incremental response during each time step with given initial strains. The general analysis allows for arbitrary creep and swelling laws as well as for multiple supports, a variable bending stiffness, temperature, and neutron flux density distribution. A description and the application are given for a computer program. Some results for SNR-type fuel elements indicate the significance and the competing effects of in-pile creep and swelling. (auth)

4537 (EURFNR-1076) POST-IRRADIATION EXAMINATION OF FUEL PIN R54-F20^A, IRRADIATED IN A NaK ENVIRONMENT. Kwast, H. (Reactor Centrum Nederland, Petten). Dec 1972. 66p. (RCN-181). Dep. NTIS $5.45.

Fuel pin R54-F20^A was irradiated in a NaK-environment. Temperature measurements in the NaK were carried out at average linear fission powers of 552 and 825 W/cm respectively. A maximum average canning temperature of 920°C was reached. The fuel pin was irradiated for about 50 min at the maximum irradiation conditions, while the total irradiation time was 2h. The irradiation had to be broken off before the end condition was reached because of malfunctioning of the fuel failure detection system. No power peaking did occur at the upper and lower interfaces between the 50%-enriched UO_2^- and the natural UO_2 + 8 w/o UB_4 pellet. About 35% of the fuel was molten, but the fuel pin did not fail. The irradiation was carried out in the Poolside Facility (PSF) of the High Flux Reactor (HFR) at Petten. (auth)

4538 (GEAP-12368) THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 21, August 1, 1972-October 31, 1972. Aitken, E. A.; Dutina, D.; Adamson, M. G.; Evans, S. K.; Ludlow, T. E. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). Nov 1972. Contract AT(04-3)-893. 13p. Dep. NTIS $4.00.

Progress is reported on the continuing scope of work related to fission product cladding interactions, sodium fuel chemical interactions, and O:M and Pu:U redistribution. (auth)

4539 (GULF-GA-A-12421) GAS-COOLED FAST BREEDER REACTOR. Quarterly Progress Report, August 1-October 31, 1972. (Gulf General Atomic Co., San Diego, Calif.). 8 Dec 1972. Contract AT(04-3)-167. 85p. Dep. NTIS.

The tasks of the Gas-Cooled Fast Breeder Reactor (GCFR) program supported by the U. S. Atomic Energy Commission are program planning, core development, development of pressure equalization system for fuel rods, fuels and materials development, and nuclear analysis and reactor physics. Core development work included structural and thermal analyses of the fuel-element assembly, studies of the effects of fuel hot-pressing with burnup on fuel temperature, development of an analytical model for the monitor station instrumentation for the pressure equalization system, and further criticality studies of the lower shield assembly. Work on the planning document for the pressure equalization system for the fuel rods was initiated. In fuels and materials development, the status of the thermal-flux and fast-flux irradiation programs are given. The results of postirradiation examinations to date of the GB-9 fuel rod irradiated in the thermal flux of the ORR and of the G-3 fuel rod irradiated in the EBR-II fast flux are given. Reactor physics studies included critical assembly analysis, in particular, calculations of small-sample worths, Doppler worth, β_{eff}, and prompt lifetime, and the conversion to ENDF/B Version III for GCFR calculations. (auth)

4540 (HEDL-TME-72-154) LMFBR REACTION RATE AND DOSIMETRY 6TH QUARTERLY PROGRESS REPORT, SEPTEMBER-NOVEMBER 1972. McElroy, W. N. (Comp.). (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 88p. AT $5.45.

Technical progress made in the Interlaboratory LMFBR Reactor Rate Program during September through November 1972 is reported. Program objectives are to measure neutron reaction rates for LMFBR fuels and materials and to improve the knowledge of nuclear parameters involved in materials dosimetry measurements. (JWR)

4541 (JAPFNR-94) FAST BREEDER REACTOR DEVELOPMENT AT PNC, JAPAN. Quarterly Progress Report, September-November 1972. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Mar 1973. 10p. Dep. NTIS (U. S. Sales Only) $4.00.

Progress is reported on construction, design and testing for equipment, components, and facilities of the Experimental Fast Breeder Reactor JOYO and the Prototype Fast Breeder Reactor MONJU. (FS)

4542 (JAPFNR-97) 2D-GAMMA: TWO-DIMENSIONAL GAMMA HEATING CODE FOR FAST REACTORS. (Mitsubishi Atomic Power Industries, Inc., Omiya (Japan)). Mar 1972. 47p. (J-206-72-02). Dep. NTIS (U. S. Sales Only) $4.00.

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

A two-dimensional X-Y code was developed to compute the gamma heating distribution in fast reactors by taking account of the photon transport. This code begins with the computation of the gamma source production, based on a given neutron flux distribution. The gamma flux distribution in the reactor is computed with the two dimensional seven groups photon transport Sn calculation. A library of gamma source and microscopic cross sections for gamma transport was prepared as an extension of a similar library developed for the one dimensional gamma heating code GAMMA. The application of the code to the power distribution calculation in "MONJU" showed that the contribution of gamma heating was 10% in the core and 24.5% in the inner blanket, and that the gamma heating in the inner blanket would increase 17% as compared with calculations which neglect the photon transport. (auth)

4543 (JUL-923-RW) AIM OF GCFR FUEL ELEMENT IRRADIATIONS IN THE HELIUM-LOOP-MOL. Krug, W.; Stehle, H. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorwerkstoffe). Feb 1973. 41p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

Irradiations are planned in the He-Loop-Mol in the BR-2 reactor at Mol/Belgium for vented stainless steel clad oxide fuel element bundles for a gas-cooled fast breeder (GCFR). It is the aim of these tests to study the irradiation behavior of fuel element bundles, and the operational behavior of fuel element venting. The aim of the fuel element irradiation is explained and discussed in detail. The program for preparation, testing, and post irradiation examination of the fuel elements is described. (auth)

4544 (LA-4951) THERMAL NEUTRON IRRADIATION OF SODIUM BONDED SOLID SOLUTION (U,Pu)C FUEL. Clifford, J. C. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 34p. Dep. NTIS $3.00.

Small amounts of pelletized, single-phase, uranium-plutonium carbide, sodium-bonded to Type 316 stainless steel cladding, were irradiated in a thermal flux to determine whether fuel, clad, and sodium would remain mutually compatible as burnup progressed. Uranium for the fuel was fully enriched in ^{235}U, producing a surface-to-centerline fission ratio of ~12 : 1. During these irradiations, the maximum fuel surface operating temperature was 730°C, the maximum power density was 760 W/g, and the maximum burnup attained was 13 at.%. These figures are based on fission events only. The irradiated fuel showed no evidence of attack by sodium and no other surface changes, although extensive cracking, sodium logging, and a noble fission-product-containing phase were observed in various samples. The cladding on inside surfaces showed evidence of light, intermittent carburization at all operating temperatures (600 to 720°C), and Sigma-phase formation, due to thermal aging, at the highest test temperatures. No evidence was found that would preclude testing of sodium-bonded, single-phase, uranium-plutonium carbide fuel in a fast flux at lineal power ratings of ~30 kW/ft to burnups of 10 to 12 at.%. (auth)

4545 (LMEC-71-2) NEUTRON RADIOGRAPHY FEASIBILITY STUDIES FOR STEEL EXAMINATION FOR THE LIQUID METAL FAST BREEDER REACTOR PROGRAM. Golliher, K. G. (Atomics International, Canoga Park, Calif. Liquid Metal Engineering Center). 30 Jan 1973. Contract AT(04-3)-700. 49p. AT $3.00.

Neutron radiographs of specimens, representing Liquid Metal Fast Breeder Reactor components, were made at the Shield Test and Irradiation Reactor. The specimens were radiographed through the neutron-perturbing environments of sodium, piping insulation material, and additional steel in an attempt to mock up the LMFBR primary containment vessel and the main coolant header. Calculations and measurements of the neutron energy distribution used for the tests were made and compared to that in a Liquid Metal Fast Breeder Reactor. The radiographs produced are an evaluation of the feasibility of using neutron radiography to perform, in situ, vessel and piping examination. (auth)

4546 (RDT-E-2-4-T(4-73)) SHIELD PLUG AND CLOSURE CAP FOR PENETRATIONS: LMFBR REACTOR VESSEL HEAD. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 20p. RSO.

This standard establishes the requirements for construction, packaging, and delivery of shield plugs and closure caps for use in sodium cooled reactors. The shield plugs and closure caps are used to provide radiation shielding and environmental control of penetrations in the reactor vessel closure head. (auth)

4547 REACTOR CONTAINMENT VESSEL OF JOYO. Doryokuro, Giho; No. 2, 31-52(Nov 1971). (In Japanese).

Pressure and leakage testing of the reactor containment vessel for the "Joyo" experimental fast breeder reactor was finished without accident in August, 1971. The accidents to be taken into consideration in the design of reactor containment are criticality excursions and sodium fires. From the most strict conditions of previous accidents, it was decided that design pressure should be 1.35 kg/cm^{2}G and temperature 150°C. In order to hold radioactive materials emitted in an accident, the reactor containment vessel needs to be airtight. The design rate of leakage was decided as 0.7 %/day following an accident. The design of the reactor containment vessel was performed on the basis of the ASME Code Section III. Manufacture of the containment vessel in a factory was accomplished on June 29, 1971. In January 1971, installation of the reactor containment vessel was begun, and on August 24, 1971, the pressure and leakage testing was finished without accident. The pressure test was performed for 30 minutes under an air pressure of 1.69 kg/cm^{2}G, and the leakage test was carried out using soapsuds under the pressure of 1.35 kg/cm^{2}G. The leakage rate was measured to be -0.0039%/day by the absolute pressure method, or -0.027%/day by the standard vessel method, against the design leakage rate of 0.03%/day. (JA)

4548 EARTHQUAKE-PROOF DESIGN OF THE EXPERIMENTAL FAST BREEDER REACTOR JOYO. Akino, K.; Kato, M. (Japan Atomic Power Co., Tokyo). Doryokuro Giho; No. 3, 45-54(Feb 1972). (In Japanese).

The elemental procedures for designing the earthquake-proof structures of the Joyo experimental fast breeder reactor including the buildings are presented. As the basement of the buildings cannot be placed immediately upon the base rock, the foundation must be 32 meters deep. The maximum seismic acceleration at the base rock for the safety design was assumed as 3.2 cm/sec from various data obtained. For the earthquake response computation, two analytical models were used; one for buildings and the containment vessel and the other for the reactor vessel and its internals. The finite element method was applied to the computation. The entire reactor plant, with its reactor building, all attached equipment (trenches, cable-tunnels, etc.) and building accessories were designed so as to form a firmly united rigid construction. The earthquake-proof designs of the fuel assembly, piping systems, and graphite shielding structure are also referred to. (JA)

4549 FAST NEUTRON REACTORS. Denielou, G. (CEN de Cadarache, Saint-Paul-les-Durance, France); Vautrey, L. Recherche (Paris); 4: No. 31, 143-153(Feb 1973). (In French).

The principles of fast breeder reactor are recalled, and the advantages that they present are discussed. In most present day reactors Na is used as the coolant fluid, mixed UO_2-PuO_2 oxide as the fuel, and ^{238}U in the form of UO_2 as the fertile material. (FR)

4550 OPERATION EXPERIENCE AND FUTURE PLAN OF SODIUM FLOWING HEAT TRANSFER TEST LOOP. Ishibashi, E. (Power Reactor and Nuclear Fuel Development Corp., Oarai, Japan). Doryokuro Giho; No. 2, 53-62(Nov 1971). (In Japanese).

The sodium test loop was constructed to perfect the sodium technology needed for the "Joyo" experimental fast breeder reactor, and to perform endurance tests of fuel assemblies for the "Monju" prototype fast breeder in high temperature sodium. This test loop was designed and manufactured with the idea that materials, structures, and manufacturing processes will be applied to Joyo in the future. In a main loop system, a mechanical sodium pump of 5 m^3/min, a main cooler, a 250 kilowatt electric heater, an expansion tank and a sodium refining system are included. In September and October 1969, 17 tons of sodium was put into a sodium storage tank without any accident. A trial run was performed from November 1969 to March 1970. During this trial run, only one sodium leakage accident happened. Characteristic test of the mechanical pump, the cooler, etc. was performed in 1970. On November 20, 1970, accumulated operation time exceeded 5000 hours, and the first objective was achieved. In order to perform the flowing endurance test of mock fuel assemblies, the loop was remodeled. Accumulated test time of the fuel assemblies now exceeds 1250 hours. (JA)

4551 CONTRACTING PARTIES AND PARTICIPANTS IN THE PROJECT OF THE 280 MW(e) PROTOTYPE SODIUM-COOLED FAST BREEDER REACTOR (SNR-300). Pressedienst (Bundesmin. Bild. Wiss.); No. 11, 5-6(1972). (In German).

The interrelations existing between the governments, the party

placing the order, and the contractors participating in the SNR-300 project are reviewed. (GF)

4552 SODIUM-COOLED REACTOR PLANT KNK: WORK FOR REDESIGN CONTINUES. Pressedienst (Bundesmin. Bild. Wiss.); No. 14, 5-6(1972). (In German).

Described are the decisions taken by the commission set up in January 1972 to examine the project KNK II for reconstruction of the KNK into a sodium-cooled test reactor with a fast core. (GF)

4553 DEVELOPMENT OF FAST BREEDER REACTORS. Haefele, W.; Faude, D. (Kernforschungszentrum, Karlsruhe, Ger.). Umschau; 71: No. 20, 727-730(1971). (In German).

4554 TELLURIUM, CAESIUM, IODINE, AND METHYL IODIDE IN FAST REACTORS. Clough, W. S.; Fraser, A. (Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Energy; 27: No. 1, 1-14(Jan 1973).

The vaporization of iodine, tellurium and cesium from solution in liquid sodium has been investigated in laboratory experiments which simulate conditions in a fast reactor. The vaporized species were carried in a stream of inert gas to a chamber where rapid cooling caused aerosol formation. The aerosol formed, which was predominantly sodium, contained iodine and cesium in the same concentration as that in the vapor from which the aerosol was formed. Tellurium is more volatile than has been predicted previously but, in these experiments, it was not incorporated into the sodium aerosol. The reaction between sodium vapor and methyl iodide has been shown to be very rapid at temperatures above 450°C but an oxidized sodium aerosol has little effect on the rate of breakdown of methyl iodide. (auth)

4555 NUCLEAR REACTOR FUEL ELEMENT. Cayol, A.; Clottes, G. (to Commissariat a l'Energie Atomique). French Patent 2,116,195. 13 Jul 1972. Filed date 28 May 1970. 7p. (In French).

The fuel element for a Na cooled fast neutron reactor is intended to be used vertically and consists of a sealed cladding, and a column of pellets (made of fissile or fertile material) supported by a support attached to the fuel can. This support is provided with at least one passage which is parallel to the axis of the fuel element. An intermediate part is interpositioned between the column and the support and slides freely in the can. The cylindrical wall of the intermediate part is provided with longitudinal grooves joining the two sides of the part, the end faces being provided with radial grooves leading into the longitudinal grooves. (FR)

4556 NUCLEAR FUEL ASSEMBLY. Skok, J. (to Commissariat a l'Energie Atomique). French Patent 2,115,003. 7 Jul 1972. Filed date 20 Nov 1970. 10p. (In French).

A nuclear fuel assembly for a fast liquid metal cooled reactor is described. The assembly possesses at least one bundle of clad pins arranged in a regular lattice inside a cooled envelope. A spacing wire is helically wound along most of the length of each pin. This spacing wire fixes the minimum separation between a pin and a neighboring pin or the envelope. The localized pressure drop producing elements are regularly distributed along the lateral sub-canals defined by the envelope and the pins at the side of the bundle. (FR)

4557 BREEDERS. Risks Man Dare Not Run. Tinker, J. New Sci.; 57: No. 835, 473-476(1 Mar 1973).

Breeders are inherently more dangerous than conventional nuclear power stations and they make the totally unsolved problem of long-life radioactive wastes a thousandfold more intractable. A breeder economy will for the first time place weapon-grade plutonium within the grasp of any power government, criminal organization, lunatic or terrorist group. (UK)

4558 CHANNEL DEFORMATION ANALYSIS FOR FAST REACTOR FUEL ASSEMBLIES UNDERGOING SWELLING AND THERMAL BOWING. Ohmae, K.; Morino, A.; Nakao, N.; Hirao, S. (Hitachi, Ltd., Japan). Nucl. Eng. Des.; 23: No. 3, 309-320 (1972).

Differential thermal expansion and swelling of fuel pins, hexagonal flow ducts and fuel pin spacers, fuel pin bowing between the spacers due to subchannel temperature differentials, and fuel pin bundle bowing due to the cambered hexagonal wrapper tube were analyzed for sodium-cooled fast reactor fuel assemblies. A FORTRAN IV computer program (CDA) was developed to calculate the flow area of the deformed coolant channels. This is subsequently fed into a conventional thermal analysis code, such as COBRA-II, to obtain the converged temperature distribution with the fuel assembly of interest. (auth)

4559 PLAN FOR SURVEYING THE FUTURE OF FAST-REACTOR INDUSTRY BY DELPHI PROCEDURE. Genshi Doryoku Kenkyukai Teirei Kenkyukai Nenkai Hokokusho; No. 45, vp.(Aug 1971). (In Japanese).

To probe into the future aspects of the fast-reactor industry, an ad hoc sub-committee studied the method or form of investigation to be made a questionnaire, according to the Delphi procedure. Results of this question-and-answer survey will be given in the next annual report. The form of the questionnaire, and its contents are given. The questionnaire comprises the following items, technology prospect including reactor physics, fuel, sodium techniques, and safety and containment; future development, including economical prospect; and multi-purpose utilization. The items of investigation are: nuclear constants and accuracy, and research procedure; mixed oxide fuel and cost; sodium system, pumps and steam generators; re-criticality accident and types of containment vessels; comparison with conventional power plants, development of fast breeder reactors and cost, and Japan's supply of plutonium; and the utilization as industrial heat sources. (JA)

4560 RESPONSE OF A FAST REACTOR SUBASSEMBLY WRAPPER TO INTERNAL PRESSURES GENERATED IN AN ACCIDENT. Judd, A. M. (Cambridge Univ., Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 159-166(Apr 1973).

A small-scale accident in a sodium-cooled fast reactor may generate high pressures inside a fuel subassembly. After irradiation the wrapper will be brittle, and the pressure may burst it, allowing damage to spread to the rest of the core. The response of an irradiated wrapper to internal pressures is analysed, and the pressures generated by release of fission-product gas from failed fuel or by thermal interaction of molten fuel and coolant are investigated. It is concluded that gas release cannot cause wrapper failure, but fuel-coolant interaction may if it is as violent as recent experiments indicate. (auth)

4561 FACTORS AFFECTING THE ENDURANCE POTENTIAL AND SAFETY OF SODIUM BONDED (U, Pu)C FUEL PINS. Paris, R.; Demant, J. T. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 183-192(Apr 1973).

Theoretical and experimental work to explore the effects of possible defects in sodium bonded pins and reactor transients on fuel element safety and endurance are reviewed. Pins rated at 140 kWm^{-1} should withstand up to 25% debond before sodium bond boiling occurs. Clad carburization normally found in irradiated pins is well below the level deemed to give an unacceptable degradation of mechanical properties. Debris in the bond space does not contribute to clad strain in most experiments but strain has occurred in one series of irradiations in which the fuel fragmented. Out-of-pile tests suggest fission gas bubbles could form large bond voids but no harmful effects have been observed in post-irradiation examination. Complete removal of the bond by clad failure during irradiation may cause fuel melting, but computer analysis and limited in-pile tests indicate that this should not cause clad melting. Computer simulations indicate that sodium bonded pins are better able to resist abnormally high transients than gas bonded pins, and although it is recognized that coolant channel blockage could result in rapid failure of sodium bonded pins, the failure of gas bonded oxide or carbide pins would also be very rapid, so that it is desirable to develop a subassembly design which renders this event unlikely. The higher burn-up potential, the lack of fuel/clad mechanical interaction, and the high potential breeding gain of sodium bonded compared with gas bonded fuel sufficiently outweigh the disadvantage of limited experience and the slightly smaller safety margin in a loss of coolant situation to make sodium bonded carbide fuel a serious contender as a fast reactor fuel. (auth)

4562 EVALUATION OF THE INFLUENCE OF SOME CONCRETE CHARACTERISTICS OF NONLINEAR BEHAVIOR OF A PRESTRESSED CONCRETE REACTOR VESSEL. Khan, M. H. (Bonnand and Gandel, Lausanne, Switzerland); Saugy, B. pp 159-179 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

Nonlinear behavior up to rupture of wall of a PCRV, having large cylindrical vertical cavities for direct cycle turbines, was examined with the aid of the finite-element method. It is admitted that the surface of rupture of concrete is composed of a cone in the tension zone and a truncated cone in the compression zone, in the coordinate system of principal stresses. The influence of the variation of this surface of rupture, in the tension zone, on the cracking in the vessel wall and on the ultimate pressure load capacity is first analyzed. The tensile strength of the concrete is varied from 0 to 7.5% of its compression strength. Secondly, the influence of variation of the stress–strain law of concrete on nonlinear behavior of vessel wall, up to rupture, is determined. 6 references. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 2635, 4588, and 4589.

4563 (BARC/I-177) BUCKLING STRENGTH OF CIRUS CALANDRIA TUBE. Kakodkar, A.; Charan, J. J. (BHABHA Atomic Research Centre, Bombay (India)). 1972. 7p. INIS.

An experiment conducted to check the buckling strength of the calandria tube of the CIRUS reactor at Trombay, is reported. A 4'' O. D. 14 SWG aluminium tube was mounted on a fixture consisting of a 2'' diameter M. S. bar screwed at both ends, and heated with an isotope. The tube was supported on two guides at the ends of the bar to give end fixity. During the experiment the strain on the tube, temperature at 3 points on the bar and 4 points on the tube were monitored. The expansion of the whole set-up was measured by dial gages fixed at both ends. Average temperatures, strains and the total expansion were measured. The strain gage readings plotted with respect to the bar temperature showed a clear maximum at strain reading of 0.12% corresponding to 0.06% buckling strain. The factor of 2 observed is accounted for by the arrangement of strain gages in the experiment and by the instrument reading being twice that at the actual strain. For the experimental tube, buckling load corresponding to 0.06% strain was 9100 lbs which showed a close agreement with the buckling load of 10500 lbs calculated from Rankinl's formula for fixed ends. This was confirmed at varying temperatures. (INIS)

4564 (DR-52) PROJECT OF A CRITICAL ASSEMBLY. Codes Under Development. Pinheiro, R. B. (Minas Gerais Univ., Belo Horizonte (Brazil). Divisao de Engenharia de Reactores). Jan 1972. 67p. (In Portuguese). INIS.

Several codes were developed for the calculation of a light water assembly. The fuel, cladding and moderator were considered to be in a concentric cylinder arrangement. PROTER (Program Thermalization) code processes typical calculations in 30 minutes by an IBM 360/40 over the regions divided in 10 sub-regions. MUFT (Multigroup Fourier Transform Calculation) code solves Boltzmann transport equation for moderation, using P1 or B1 approximation in 54 groups of energy. (INIS)

4565 (EUR-4896(Vol. 2), pp 965-973) PRODUCTION OF MONOENERGETIC NEUTRONS AT REACTORS BY RESONANCE SCATTERING AND FILTERS. Mlitzke, E. (Physikalisch Technische Bundesanstalt, Brunswick). Sep 1972. (In German).

From 1st symposium on neutron dosimetry in biology and medicine; Neuherberg/Munich, Germany (15 May 1972).

For producing a beam of quasimonoenergetic neutrons around E_0 = 2.2 keV, an experimental arrangement is proposed consisting of a sodium scatterer (resonance energy 2.85 keV) positioned in the center of an experimental channel penetrating the reactor core and a manganese scatterer (resonance energy 2.375 keV) outside the reactor. The calculated energy distribution is compared with that of the scattering from two sodium discs. In the latter case no resonance double-scattering occurs due to the energy loss in the first scatterer. This energy loss, which depends on scattering angle, is such that these neutrons can be double-scattered very effectively by the scattering resonance of manganese whereas background scattering is strongly reduced. Resonance double-scattering is therefore superior to other methods of resonance known up to this time. Scandium and iron utilized for filtering a reactor beam produce quasimonoenergetic neutrons around 2 keV and 25 keV. By varying the thickness of the filters the background of fast neutrons and γ-radiation may be reduced to a desired value. (auth)

4566 (LA-5189-MS) NUCLEAR FURNACE-1 TEST REPORT. Kirk, W. L. (comp.). (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 112p. Dep. NTIS $3.00.

Results from the highly successful tests of the Nuclear Furnace-1 reactor are reported. The reactor, its instrumentation, and the test facility are described; and a chronology of the Experimental Plans which constituted the test series is given. Conclusions reached from the analysis of the test data are outlined, together with the observations made during disassembly and postmortem inspection of the reactor components. Results of experiments on the effluent cleanup system are also discussed. (auth)

4567 (N-72-31663) EXPERIMENTAL PHYSICS CHARACTERISTICS OF A HEAVY-METAL-REFLECTED FAST SPECTRUM CRITICAL ASSEMBLY. Summary Report. Heneveld, W. H.; Paschall, R. K.; Springer, T. H.; Swanson, V. A.; Thiele, A. W.; Tuttle, R. J. (Atomics International, Canoga Park, Calif.). 28 Jan 1972. Contract NAS3-14421. 138p. (NASA-CR-120959; AI-72-33; SR-2). NTIS.

A zero-power critical assembly was designed, constructed, and operated for a series of benchmark experiments dealing with the physics characteristics of a UN-fueled, Li-cooled, Mo-reflected, drum-controlled compact fast reactor for use with a space-power electric conversion system. The range of the previous experimental investigations has been expanded to include the reactivity effects of: (1) surrounding the reactor with 15.24 cm (6 in.) of polyethylene, (2) reducing the heights of a portion of the upper and lower axial reflectors by factors of 2 and 4, (3) adding 45 kg of W to the core uniformly in two steps, (4) adding 9.54 kg of Ta to the core uniformly, and (5) inserting 2.3 kg of polyethylene into the core proper and determining the effect of a Ta addition on the polyethylene worth. (auth)

4568 TEMPERATURE OF A THERMAL NEUTRON BEAM FROM THE RV-1 REACTOR. David, L.; Medina, R.; Parra, R.; Mendoza, G. (Instituto Venezolano de Investigaciones Cientificas, Caracas). Acta Cient. Venez.; 23: No. 3, 103-107(1972). (In Spanish).

Several measurements based on the transmission method were carried out for determining the temperature of the thermal neutron beam which escapes from the horizontal tube No. 2 of the RV-1 reactor. The attenuation of neutrons produced by boron absorbers was measured by means of a scintillation detector made of B_2O_3 + ZnS (Ag). The theory of the method is briefly deduced and the experimental conditions are described. The measurements performed at the 30 kW power level have provided the temperature of thermal neutrons T = 182 ± 6°K. (auth)

Production and Materials Testing and Processing Reactors

Refer also to abstract 2567.

4569 (JAERI-M-4920) OPERATION REPORT ON THE LOW TEMPERATURE FISSIOCHEMICAL LOOP (LTFL). II. Operations During the Period of April 1970 to March 1971. Sato, S.; Moriyama, N.; Ikezoe, Y.; Kobayashi, T.; Sukegawa, T. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 30p. (In Japanese).

The Low Temperature Fissiochemical Loop (LTFL) has been operated six times, irradiating 21 capsules during the F. Y. 1970-1971 period. Prior to these irradiation operations, the loop was inspected by Atomic Energy Bureau, the Science and Technology Agency, and the safety aspects of the chemical irradiation systems were examined by the Committee on the Operation and Maintenance of Reactors, JAERI. The preoperation inspection and the safety examinations are described in detail. The first run was unsuccessful due to the faulty limit switches which led to a series of accidents, though not serious. The steps taken to eliminate such operational troubles included the improvement on the capsule control circuit in irradiation and the procedure of handling the capsules. Other improvements made were tungsten arc welding of the capsules, compound strain gage elements, and revised operation check sheet. These alterations resulted in the last three successful runs, preparing the way for the regular operations in the next year. In the last run, four capsules loaded with nuclear fuels were thus irradiated successfully. The samples used for irradiation were nitrous oxide, ethylene and carbon dioxide mixed with nitrogen dioxide, for the purposes of dose rate distribution measurement in the LTFL in-pile plug and development of the reactor radiation dosimetry. (auth)

4570 (ORNL-TM-4139) EXAMINATION OF THE IRRADIATED 6061 ALUMINUM HFIR TARGET HOLDER. Farrell, K.; King, R. T.; Jostsons, A. (Oak Ridge National Lab., Tenn.). May 1973. Contract W-7405-eng-26. 65p. Dep. NTIS $5.25.

A 6061 aluminum alloy target holder from the High Flux Isotope Reactor (HFIR), originally in a precipitation-hardened condition, was examined for radiation damage after exposure to a maximum fast neutron fluence of 9.2×10^{22} neutrons/cm^2 (E > 0.1 MeV) and a thermal fluence of 1.38×10^{23} neutrons/cm^2 (E < 0.414 eV) at ~60°C. Voids and a precipitate of transmutation-produced silicon were found to cause about 1.1% internal swelling, and a surface oxide scale contributed additional dimensional change. Significant strength increases were measured at test temperatures in the range 25 to 200°C and are attributed to the silicon precipitate and to irradiation-induced dislocations. There was a corresponding loss of ductility which was particularly severe at 200°C for slow strain rate testing conditions. The fracture mode appeared to remain transgranular over the range of test temperatures. Specimens tested at temperatures between 200 and 500°C, at which the microstructure was unstable, showed considerable loss in strength but a concurrent gain in ductility. The strength and ductility of specimens containing 4043 aluminum weld metal

were found to be similar to those of the 6061 aluminum-base metal. (auth)

4571 (SRARI-P-174) CALIFORNIUM-252 BUILD-UP IN THE CENTRAL CHANNEL OF THE SM-2 REACTOR. Gavrilov, V. D.; Zamyatnin, Yu. S.; Ivanenko, V. V.; Yakovlev, G. N. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad (USSR)). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The results of an investigation of ^{252}Cf build-up in the central channel of the SM-2 Reactor during irradiation of ^{242}Pu and ^{243}Am are presented. The practical use of activation detectors for the neutron yield determination in irradiated specimens is considered. The rates of ^{252}Cf build-up in reactors with different hardness of the neutron spectrum are compared. (auth)

4572 CONCRETE FOR RADIATION SHIELDING: IN PERSPECTIVE. Davis, H. S. (Douglas United Nuclear, Richland, WA). pp 3-13 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

A historical outline of the use of concrete for radiation shielding is presented with particular emphasis on the Hanford operations in the state of Washington. (auth)

4573 N-REACTOR SHIELDING. Davis, H. S. (Douglas United Nuclear, Inc., Richland, WA). pp 1109-1161 of Concrete for Nuclear Reactors. Vol. II. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.2).

Twenty-five different types of concrete, including mortar and grout, were used in the construction of shielding structures for the Hanford Nuclear Power Reactor. The reactor shield is unique because of its large size, exacting dimensional tolerances, and the fact that parts of it operate at temperatures as high as 320°C. Data are presented which describe physical properties of shielding aggregates and concrete used during shield construction. The secondary shielding structure, which also functions as the reactor confinement barrier, was made of conventional concrete. Shielding concretes include iron-serpentine, hydrous-iron, magnetite, and ferrophosphorous concrete. Included are portions of a laboratory report, prepared by the Corps of Engineers, which describes investigative work performed in support of NPR shield construction on four types of high-density concrete. (auth)

Propulsion and Package Reactors

Refer also to abstract 4567.

4574 (TM-62-6-6) SIZING AND APPLICATION OF BERYLLIA SYSTEMS WITH FUEL LOADINGS OF 10 TO 45 WEIGHT PERCENT URANIA. Brunner, J. M.; Nassano, R. N. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 1962. Contract AT(40-1)-2847. 37p. Dep. NTIS.

Declassified 4 Nov 1971.

Curves for thermal and nuclear sizing of ceramic reactors with fuel loadings of 10 to 45 wt. % UO_2 are presented. Also included is a discussion of preliminary calculations for using ceramics in the marine propulsion 630A application. (auth)

4575 COLLOIDAL-GAS CORE REACTOR. von Chain, H. J. P.; Keller, M. R. (to Secretary of the Air Force). U. S. Patent 3,711,370. 16 Jan 1973. Filed date 13 Jan 1970. 8p.

A colloidal-gas core nuclear reactor having a high tensile strength outer semispheroidal pressure shell enclosing a moderator body member which surrounds a central cavity with an expanding exit nozzle at one end is described. The cavity wall has a gradually increasing radius from the nozzle end in a direction upstream within the cavity. A hydrogen gas manifold is positioned at the maximum radius of the cavity and supplies gas to the cavity through a plurality of annularly positioned swirl vanes. Additional hydrogen gas is supplied to the cavity with a tangential component through nozzles positioned in a plurality of positions of the cavity wall adjacent the exit nozzle to prevent the flow of nuclear particles along the forward wall boundary layer to the exit nozzle. (Official Gazette)

4576 DESIGN OF SHIELDING. The Reactor Shield of the First Nuclear Ship Mutsu. Genshi Doryoku Kenkyukai Teirei Kenkykai Nenkai Hokokusho; No. 45, vp. (Aug 1971). (In Japanese).

A primary shielding vessel of a reactor for "MUTSU" was concreted with heavy-concrete by a pre-packed method. Various preliminary tests and actual size experiments were performed to investigate anticipated problems before starting work. Results of the experiment and actual work, materials used, and the outline of the actual work are described. The arrangement of the pouring pipes and aggregate material and the mixing rate and control of mortar pouring are given. Items and problems of shielding measurements that will be performed during reactor load test and experimental navigation of "MUTSU" are described. A table containing shielding design criteria and figures explaining the shield of the "MUTSU" reactor are also presented. (JA)

4577 SPACE PROPULSION IN THE YEAR 2000. Jaumotte, A. L. (Univ., Brussels). Bull. Cl. Sci., Acad. Roy. Belg.; 58: No. 6, 692-709(1972).

Reactor Safety and Environmental Aspects

Refer also to abstracts 2568, 2610, 2982, 4527, 4675, 4678, 4776, 4807, 4827, 4848, 4945, and 4946.

4578 (AEC-tr-7425) ACCIDENT ANALYSIS IN NUCLEAR TECHNOLOGY SAFETY: A CALCULATED RISK. Kellermann, O. Translated from Tech. Ueberwach.; 13: No. 11, 330-335 (1972). 18p. Dep. NTIS $3.00.

The role of accident analysis in nuclear power plant planning is surveyed. Statistical calculations of risks are discussed and compared with accident risks associated with non-nuclear activities. (JWR)

4579 (CEA-Bib-207) OFFSHORE NUCLEAR POWER PLANTS. Cotton, C. M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). May 1973. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

A bibliography of 45 papers published from 1970 to 1972 about offshore nuclear power plants is presented. Abstracts of the papers are included. (auth)

4580 (CONF-730304-4) ESTIMATE OF EFFECT OF LOCALIZED FLOW BLOCKAGES ON PWR CLAD TEMPERATURES DURING REFLOOD. Gambill, W. R. (Oak Ridge National Lab., Tenn.). 1972. 26p. Dep. NTIS $3.50.

From National Topical Meeting on Water Reactor Safety; Salt Lake City, Utah, USA (26 Mar 1973).

Calculations were made of cladding temperature changes associated with various localized blockages during reflood following a PWR LOCA. A physically realistic model which allows for radial flow-diversion effects was adopted by equating pressure drops for regions of high blockage with pressure drops for parallel regions of lesser or zero blockage over various flow-disturbance heights. The choice of the heights with which the blocked-region flow reductions were calculated was guided by experimental and calculated values for the upstream-diversion and downstream-redistribution lengths below and above the blockage corresponding to pressure/flow radial equilibration. The maximum value of total flow-disturbance length selected corresponds to 30% of the height of a 12-ft bundle. The analysis yields hot-pin cladding temperatures for nine of the ten blockage combinations examined that exceed the temperature for the unblocked case by 400°F or more. By introducing a nonarbitrary, but uncertain, blocked-region heat-transfer coefficient multiplier of ~1.5 in an attempt to account for reduced-equivalent-diameter and entrance-region effects, the peak cladding temperatures were reduced significantly. Negative values of Δt_{clad} were predicted for some blockage combinations; but the results were strongly dependent on the radial blockage distribution, and the increases in cladding temperature for a 90% blockage embedded in a region of 0% blockage, for 90% in 50%, for 90% in 70%, and for 80% in 0% were ≥400°F. When the heat-transfer coefficient multiplier was increased to 2.0, the cladding temperature increase for only the 90% in 0% and 90% in 50% cases remained above 400°F. These estimates of clad temperature rise for high blockage significantly exceed other published estimates, which apparently correspond to overall hot-assembly flow reductions in the absence of lateral flow diversion. (auth)

4581 (CONF-730304-5) PWR BLOWDOWN HEAT TRANSFER SEPARATE-EFFECTS PROGRAM. Lawson, C. G.; Chapman, R. H.; Hoffman, H. W. (Oak Ridge National Lab., Tenn.). [nd]. 34p. Dep. NTIS $3.75.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

The scope of the ORNL program covers the investigation of the thermal-hydraulic response of a simulated fuel bundle to the flow, power, and/or pressure transient that might occur during the depressurization of a hypothetical pressurized-water reactor LOCA. These investigations are to be carried out in such manner as to delineate the physical phenomena occurring during the transients. The physical constraints of flow and power available in the ORNL

experimental facilities (10 MW(e) and 900 gpm) impose only minimal limitations on the range of studies. (auth)

4582 (CONF-730304-7) COMPARISON OF THERMAL-HYDRAULIC RESPONSE OF LOFT AND A LARGE PRESSURIZED WATER REACTOR TO LOCA CONDITIONS. Davis, P. R.; Dugone, J. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1973. Contract AT(10-1)-1375. 9p. Dep. NTIS $3.00.

From national topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

An analytical study was performed to determine how closely the thermal-hydraulic response of the Loss-of-Fluid Test (LOFT) pressurized water reactor with a 5.5-foot core compares with that of a large, four-loop, pressurized water reactor with a 12-foot core under loss-of-coolant accident conditions. The analysis employed the thermal-hydraulic computer codes RELAP3 and THETA1-B to determine the hydraulic response of the primary systems during blowdown and the thermal responses of the cores during blowdown. An additional analysis was performed to assess the core thermal response during ECC reflooding. On the basis of the results of the analyses, the conclusion was reached that a 5.5-foot core operating in the LOFT system can produce thermal-hydraulic behavior representative of that calculated to occur in a four-loop large PWR with a 12-foot core during a double-ended inlet pipe break. (auth)

4583 (FIND-50317-R1) FIND: CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Raleigh, H. D. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 9 May 1973. 33p. (FIND-50318-R1). Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (FS)

4584 (GEAP-13255) BLOWDOWN HEAT TRANSFER PROGRAM. Task A1 Informal Report: 49 Rod Bundle Preliminary Test Plan. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jan 1972. Contract AT(04-3)-189. 34p. Dep. NTIS $3.75.

A program is described which will investigate the Blowdown Heat Transfer (BDHT) which will take place in a BWR in the event of the most severe conceivable accident, which is postulated as a guillotine rupture of a recirculation line at the drive pump suction nozzle. This is the Design Basis Accident (DBA). Full-sized 49-rod bundles will be tested in a scaled BWR simulator, in which system response on a real time basis will be matched as closely as possible. The test is oriented to provide representative thermal-hydraulic data under DBA conditions. Selected test parameters include: initial bundle flow rate to bundle power ratio, break size, initial value of subcooling, length/dia ratio of lower plenum, bundle power decay during transient, ratio of core entrance flow area to core bypass flow area, inertia of pump-motor-flywheel, and steam line break location. (FS)

4585 (GEAP-13274) BLOWDOWN HEAT TRANSFER PROGRAM. Task B-2 Skin Heater Feasibility Test Results. Sozzi, G. L. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar 1972. Contract AT(04-3)-189. 35p. Dep. NTIS $3.75.

Tests were conducted with direct electrically heated rods to determine their thermal and mechanical performance as related to Blowdown Heat Transfer (BDHT) testing. The results clearly demonstrate that the rods are adequate for use and repeated reuse for BDHT testing. (auth)

4586 (GEAP-13276) BLOWDOWN HEAT TRANSFER PROGRAM. Task C-1 Informal Report, Preliminary System Design Description of Two-Loop Test Apparatus. Burnette, G. W.; Danielson, D. W.; Nilsson, K. A. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar 1972. Contract AT(04-3)-189. 128p. Dep. NTIS $8.50.

A two-loop test apparatus proposed for use in the Blowdown Heat Transfer Program is described. The apparatus is to be used for investigation of reactor blowdown heat transfer phenomena during the hypothetical recirculation line break Design Basis Accident. For physical scaling purposes, a typical Boiling Water Reactor is modeled. Program background is outlined and program objectives are defined. Design basis is presented together with a detailed description of test apparatus operating performance. Measurement systems and data handling equipment are described in detail. Finally, performance predictions for the test apparatus are compared with Boiling Water Reactor expected performance and with the Design Basis Accident analysis performance. (auth)

4587 (HEDL-TME-73-24) REVIEW OF THERMAL POWER PLANT INTAKE STRUCTURE DESIGNS AND RELATED ENVIRONMENTAL CONSIDERATIONS. Sonnichsen, J. C. Jr.; Bentley, B. W.; Bailey, G. F.; Nakatani, R. E. (Hanford Engineering Development Lab., Richland, Wash.). May 1973. Contract AT(45-1)-2170. 102p. Dep. NTIS $7.25.

The environmental impact of large steam-electric power plant intake structures where water is withdrawn from the water body for subsequent in-plant usage consisting largely of turbine condenser cooling is discussed. A review of present designs and the pertinent characteristics of various water bodies serving as coolant sources to the plants is followed by a discussion of biological considerations in intake design. An attempt is made to match biological and technological demands and some economic data are presented. A review of concepts presently under development is provided and conclusions and recommendations are offered. Finally, an appendix detailing eight representative designs is included. (auth)

4588 (JABE-WADCO-4) SUPPLEMENTARY GEOLOGIC INVESTIGATIONS FOR SEISMIC EVALUATION OF THE FFTF SITE NEAR RICHLAND, WASHINGTON. (Blume (John A.). and Associates, Engineers, San Francisco, Calif.). Feb 1971. 162p. Dep. NTIS $10.25.

For WADCO Corp., Richland, Wash.

A geologic investigation to identify and delineate faults along the northeast slope of Horse Heaven Hills, in the vicinity of Badger Coule, about seven miles southwest of Richland, Washington is reported. The Wallula Gap fault, which extends northwest from Yellepit to the Horse Heaven Hills was found to be a lesser fault and to lie at a greater distance from the FFTF site than the Rattlesnake-Wallula fault. The latter fault would be capable of producing the maximum vibratory ground motion at the FFTF site. (FS)

4589 (JABE-WADCO-7) SUBSURFACE GEOLOGIC INVESTIGATIONS FOR THE FFTF PROJECT IN PASCO BASIN. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). Oct 1971. 228p. Dep. NTIS $13.50.

For WADCO Corp., Richland, Wash.

Data and data evaluation of subsurface geological investigations in an area surrounding the FFTF at Hanford Reservation are presented. Subsurface exploration was undertaken to provide confidence that there are no nearby faults of significance to the FFTF. Studies were made using chemical analysis of basalt flows, gravity, seismic refraction, magnetometer, resistivity measurements, and core drilling. Good correlation was obtained between different techniques in locating major structural elements. No faults were found which would require modification of the seismic criteria for the FFTF. (FS)

4590 (ORNL-TM-4082) ACRA: A COMPUTER PROGRAM FOR THE ESTIMATION OF RADIATION DOSES CAUSED BY A HYPOTHETICAL REACTOR ACCIDENT. Stallmann, F. W.; Kam, F. B. K. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 87p. Dep. NTIS $6.50.

The radioactive material released to the atmosphere on account of a hypothetical reactor accident is transported away by the wind and is dispersed to a 3-dimensional normal distribution. The fission product activity is described throughout the space domain as a function of time. Presently the code calculates two types of exposure from the passing cloud of finite size: internal exposure from inhalation of the radionuclides in the air, and external dose from gamma radiation. The cloud depletion terms by washout and dry deposition have not been incorporated. However, this option can be easily implemented. Up to 100 receptor locations and 20 time intervals can be handled in one run. The program accepts information for up to 300 isotopes. Computer time is about 2 seconds per receptor and time interval. This time has to be doubled if inversion layers are present. (auth)

4591 (ORNL-TM-4205) COMMENTS ON THE APPLICATION OF PWR-FLECHT EXPERIMENTAL RESULTS TO A LOCA. Gambill, W. R.; Keyes, J. J.; Kress, T. S.; Lawson, C. G. (Oak Ridge National Lab., Tenn.). 11 Apr 1973. Contract W-7405-eng-26. 96p. Dep. NTIS.

The results of four studies concerned with the PWR Full Length Emergency Cooling Heat Transfer (PWR-FLECHT) tests and the application of these test results to the calculation of temperature of fuel pin cladding under conditions that might prevail in a PWR during the reflood portion of a LOCA are presented. Results for tests with forced flow of water to the test bundle with constant flooding rate show that rates above 2 in./sec are likely to keep the peak cladding temperature of present PWR designs below 2300°F, if the temperature at the beginning of reflood does not exceed 2200°F. If the flooding begins at 5 to 10 in./sec for several seconds, a flooding rate of 1 in./sec may be sufficient to limit the peak cladding temperature. Calculations investigating the effect of core blockage in reducing the reflood rate in four-loop and two-loop, four-pump PWR plants indicate that exit flooding rates of

1.0 and 1.3 in./sec, respectively, could be expected, with a containment pressure of 50 psia. Reducing the pressure to 25 psia would reduce exit flooding rate to 0.75 to 0.9 in./sec with an unblocked core. Core wide midplane blockage greater than 90% would be required to reduce the exit flooding rate by 25%. Blockage of 70% would have a negligible effect with a containment pressure of 50 psia. The effect of droplet entrainment on heat transfer during reflood shows that at a reflood rate of 1 in./sec, droplets could increase the steam convection heat transfer coefficient from values less than one to values of 10 and 20 Btu/hr ft^2 °F. Calculations were made of cladding temperature changes associated with various localized partial flow blockages during reflood following a LOCA. Hot-pin cladding temperatures for nine of ten blockage combinations were found to exceed the temperature for the unblocked case by 400°F or more. By introducing nonarbitrary, but uncertain, blocked-region heat-transfer coefficient multipliers, peak cladding temperatures were reduced. Estimates of cladding temperature rise for high blockage significantly exceed estimates based on overall hot-assembly flow reduction in the absence of lateral flow diversion. (FS)

4592 (WCAP-8096) ANTICIPATED TRANSIENTS WITHOUT REACTOR TRIP IN WESTINGHOUSE PRESSURIZED WATER REACTORS. Topical Report. (Westinghouse Nuclear Energy Systems, Pittsburgh, PA). Apr 1973. 195p.

The adequacy of the Reactor Protection System from the standpoints of redundancy against random component failures, functional diversity provided by multiple trip functions, resistance to common mode failure, and the consequences of anticipated transients without reactor trip are analyzed. Evaluations show that multiple and diverse trip functions will terminate all anticipated transients. The likelihood of random or common mode failures resulting in failure to trip is practically zero. In the unlikely event of no trip for all anticipated transients, continued core heat removal can be maintained, and in the worst transient, peak pressures are not such as to lead to significant damage to the Coolant System. (auth)

4593 (WCAP-8110) TEST PLANS AND RESULTS FOR THE ICE CONDENSER SYSTEM. (Westinghouse Electric Corp., Pittsburgh, PA). 16 Apr 1973. 124p. NTIS $8.25.

The functional adequacy and structural integrity of the ice-condenser components was confirmed by a test program which not only confirmed the design but also confirmed the integrity of the components. Ice basket tests were performed under static, maximum, and dynamic loads. Wall panels were leak tested and tested under radial loads, shear, and pressure. Lattice frames were deflection tested and a one-quarter scale model was tested. The test procedures are to implement the evaluation of the design of ice condenser components to ensure compliance with FSAR commitments. (FS)

4594 ENVIRONMENTAL PROTECTION BY DRY-TYPE COOLING TOWERS FOR POWER PLANTS. Heeren, H. M.A.N. (Maschinenfabrik Augsburg-Nuernberg) Forschen, Planen, Bauen; No. 3, 4-9(1972). (In German).

The waste heat from conventional and nuclear power plants has been discharged into rivers or through wet-type cooling towers and water evaporation into the air. One advantage of dry cooling is that the waste heat is discharged into the air without water vapor. Besides this, the power plant site can be chosen independent of water resources. Described are developments at M.A.N. of indirect systems of dry cooling where the waste steam of the turbine is deposited in an injection condenser. This system can also be employed for larger turbine units. (GF)

4595 STOCHASTIC DECISION MAKING APPLIED TO NUCLEAR REACTOR SAFETY. Schleicher, R. W. Jr. Ithaca, NY; Cornell Univ. (1972). 147p. University Microfilms Order No. 73-7149.

Thesis (Ph. D.).

A methodology is proposed for making optimum engineering decisions regarding the design and operation of a nuclear power plant with respect to public safety. By utilizing the principle of stochastic decision making, an optimum safety strategy may be determined by a quantitative trade-off between the economic cost, a deterministic function of the design and operating procedures, and the risk, a quantitative measure of safety, which is the expectation value over the random occurrences of accidental consequences. Two consistent approaches to the determination of the optimum safety strategy are discussed and demonstrated. The first method is a constrained optimization in which a risk criteria is imposed upon the plant in the form of a limit on the expected accidental radiological dose to the public over a given period of time. The optimum strategy is defined as the least cost configuration of design and operating variables which maintain the risk criteria. The second method is an unconstrained optimization in which it is assumed that the risk has a definable economic value to society and, thus, may be traded off directly against the cost in order to determine the unconstrained optimum safety strategy. The calculation of the risk to the public is based on a stochastic model of reactor safety, in which the nuclear plant is viewed as a set of interacting systems, each of which has associated with it a random variable representing whether or not the system is functioning at a given time. If a system or combination of systems does not perform its required function, an accidental consequence results. The probability distribution of the possible accidental consequences is determined by deriving and combining the probability distributions of the random variables for each system. System failure probability is calculated as a function of checkout frequency, correlated failure probability, repair time, and checkout stress. (FS)

4596 RESPONSE OF STRUCTURES TO SEISMIC EXCITATION. Davidson, L. (United Kingdom Atomic Energy Authority, Risley, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 257-260 (Apr 1973).

One aspect of a study to assess seismic effects on a gas-cooled nuclear power station, with particular reference to the horizontal load imposed on the graphite core, i.e. the soil-structure interaction, is briefly described. Results of two other aspects also mentioned are the response of the core support including the main vessel ducts and boilers and also the response of the graphite core. A conventional stress analysis program is suggested which can be applied to forcing oscillations which have a limited number of frequencies. (UK)

4597 NUCLEAR REACTOR INCORPORATING MEANS FOR PREVENTING MOLTEN FUEL FROM BREACHING THE CONTAINMENT VESSEL THEREOF IN THE EVENT OF A CORE MELT-DOWN. Jansen, G. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,702,802. 14 Nov 1972. Filed date 16 Jun 1971. 6p.

A ceramic oxide eutectic with a relatively low melting point which will dissolve nuclear reactor fuel is employed as a barrier material to prevent molten fuel from breaching the containment vessel surrounding a nuclear reactor in the event of a core meltdown. The ceramic oxide eutectic—preferably basalt or other SiO_2–Al_2O_3 material used in the form of brick, block, or gravel—rests on a layer of depleted uranium dioxide and a layer of fire brick which insulates a cooled steel containment vessel from the basalt. In the extremely unlikely event of an accident to a fast reactor causing a gross core meltdown, the molten mass of fuel will fall onto the basalt, melting the basalt and dissolving in the pool of molten basalt thus formed. The fuel is thereby dispersed over a large volume at a temperature sufficiently low that the reactor containment is not threatened. (Official Gazette)

4598 SEISMIC VIBRATION TESTING WITH SINE BEATS. Morrone, A. (Westinghouse Electric Corp., Pittsburgh). Nucl. Eng. Des.; 24: No. 3, 344-356(1973).

Analytical developments and testing procedures are presented for a method of testing nuclear power plant equipment under simulated seismic excitations. The method utilizes a standard shape of input motion considered to envelop most of the usual seismic time histories at the supports of the equipment. Thus, equipment need not be retested for different seismic conditions. Equipment response amplifications based on single degree of freedom oscillators at resonance are derived with three actual earthquake motions. These, along with higher floor response amplifications of a nuclear power plant structure, are compared with those given by the standard shape motion to evaluate its adequacy. (auth)

4599 RADIOACTIVE WASTE QUANTITIES PRODUCED BY LIGHT WATER REACTORS AND METHODS OF STORAGE, TRANSPORTATION, AND DISPOSAL. Richardson, J. A. (Burns and Roe, Inc., Ordell, N. J.). J. Brit. Nucl. Energy Soc.; 12: No. 2, 199-211(Apr 1973).

Operational statistics for radioactive liquids, gases, and solids from light water reactors up to 800 MW(e) are tabulated, together with projections for 1100 MW(e) reactors. Handling and transportation procedures for radioactive wastes and spent fuel in compliance with USAEC and Department of Transportation regulations are described. Immobilization methods for radioactive solids for transportation to available land and burial disposal sites in the USA are identified. (auth)

4600 CONCRETE CONTAINMENT: A 1970 ASSESSMENT. Bender, M.; Whitman, G. D. (Oak Ridge National Lab., TN). pp 29-54 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

The use of concrete structures, both conventionally reinforced and prestressed, for containment has become the prevalent structural approach for large nuclear power applications. The engineering practices followed for these structures generally conform to the recommendations of ACI 318, "Building Code Requirements for Reinforced Concrete," with appropriate modifications to cover the special nature of membrane shells lined with steel or plastic. Much attention has been addressed to the matter of shear resistance of cracked membranes, an inherent characteristic of conventionally reinforced containment shells. The inelastic behavior of prestressed concrete is the matter of greatest interest for prestressed concrete containment structures. The effects of high stress and temperature accelerated creep are both pertinent factors. Because of the wide use of concrete containment structures in the growing nuclear power industry, the need for parallel growth in the technological understanding of these structures is self-evident as a part of the industry obligation to guarantee adequate provision for public safety. (15 references) (auth)

4601 EXPERIMENTAL RESEARCH ON IODINE REMOVAL CARRIED OUT WITH PSICO 0 AND 10. Guerrini, B.; Lanza, S.; Mazzini, M.; Mirandola, R. (Univ., Pisa, Italy). Serie simposi. (1971). vp. (In Italian).

From Proceedings of the nuclear symposium; Pisa, Italy.

The development of a research program on iodine removal from the inner containment system requires the use of a sophisticated experimental apparatus called PSICO 10. The main component of such apparatus is a model steel container about 100 m^3 in volume, in which spray tests may be carried out in a wide range of experimental conditions. PSICO 10 will be used for a first set of experiments on molecular iodine with spray of basic solutions, isothermal or not employing different types of sprays. A first test showed the feasibility of the experiments foreseen and a series of interesting results was obtained. Results of preliminary research carried out with PSICO 0 are also given. (INIS)

4602 CONTROL OF FILTERS IN NUCLEAR POWER PLANTS. Lanza, S. (Univ., Pisa, Italy); Mazzini, M.; Muzzi, F.; Perinetti, M. Serie simposi. (1971). vp. (In Italian).

From proceedings of the nuclear symposium; Pisa, Italy.

A critical analysis is made of the methods used for determining the efficiency of the systems for filtering the air in the collection of particles and airborne iodine. A synopsis is given of the activity performed at the Pisa University Istuto di Impianti Nucleari in order to work out the most significant test methods for filters and the study of the efficiency of iodine filters. Measurements made by Divisione Sicurezza e Controlli of CNEN in ITREC, EUREX and in the laboratory for plutonium fuel element fabrication of C.S.N. Casaccia are reported. (INIS)

4603 RELIABILITY STUDY FOR THE SAFETY ANALYSIS OF THE PRIMARY CIRCUIT OF PEC FAST REACTOR. De Cecco, L.; Di Sapia, R.; Melucci, G.; Misley, P.; Rosselli, G. F.; Zona, R. (CNEN, Bologna). Serie simposi. (1971). vp. (In Italian).

From proceedings of the nuclear symposium; Pisa, Italy.

In the preliminary safety report of the PEC reactor, "credible" accidents were studied according to a probabilistic approach. Such an analysis results in a more rational design of the plant expressing itself in a more balanced and homogeneous degree of reliability both from the point of view of accident prevention and safety. The use of this method makes it possible to use a simpler control system. Some accidents, taken into account in the preliminary safety report, are described, deriving from the failure of a single component or from a series of failures in many components. This facilitates identification of those components which are critical for safe operation of the plant. It appears possible to have safe operation for the PEC reactor using reliability data of the components presently available in the specialized literature. (INIS)

4604 PRESSURE VESSELS AND PIPING: DESIGN AND ANALYSIS. A Decade of Progress. Volume One. Analysis. Bohm, G. J.; Cloud, R. L.; Hsu, L. C.; Pai, D. H.; Reedy, R. F. (eds.). New York; American Society of Mechanical Engineers (1972). 777p. $35.00.

Thirty-seven papers were presented. A separate abstract was prepared for each of 5. One paper appeared previously in NSA as abstract 26:6372. The remaining 31 papers are not within the scope of NSA. (LCL)

For abstracts of individual papers see: 2504 and 4605–4608.

4605 PLASTIC FATIGUE ANALYSIS OF PRESSURE COMPONENTS. Tagart, S. W. Jr. (General Electric Co., San Jose, CA). pp 209-226 of Pressure Vessels and Piping: Design and Analysis. Vol. I. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

Described is a simplified extension of ASME's III-type nuclear pressure-vessel fatigue analysis to cover operating conditions in which purely elastic discontinuity analysis is inappropriate because the "3 S_m limit" is exceeded. The simplified analytical method uses the elastic-strain invariance principle to obtain approximate strain distributions and to apply to the elastically calculated nominal strains a K_ϵ correction factor to account for gross plasticity effects; describes plastic effects on the fatigue strength reduction factor usually needed in such analysis; and discusses the effects of possible cyclic progressive distortion or ratcheting. The simplified elastic-plastic analysis method appears in the USAS B31.7 Nuclear Power Piping Code, Draft USA Standard (February, 1968). (auth)

4606 FATIGUE CRACK GROWTH IN PRESSURIZED WATER REACTOR VESSELS. Riccardella, P. C.; Mager, T. R. (Westinghouse Electric Corp., Pittsburgh). pp 321-340 of Pressure Vessels and Piping: Design and Analysis. Vol. I. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

The concepts of linear-elastic fracture mechanics are applied to perform a fatigue evaluation of a pressurized water reactor vessel. The results of this work indicate that for the types of flaws which could exist in a reactor vessel, fatigue crack growth due to normal operating conditions during the design life of the vessel is negligible. A simplified technique was previously presented to approximate the potential for fatigue crack growth in the beltline region of a typical pressurized water reactor vessel during the forty-year design life of the vessel. The beltline region is the most critical from the standpoint of irradiation embrittlement of the material and thus was the first to be considered. However, there are several areas in a reactor vessel which are more critically stressed during operation than the beltline region, and the crack growth in these regions must be considered before any general conclusions are drawn concerning the vessel. The following four regions of the reactor vessel are considered separately: the closure head; the nozzle shell course; the beltline region; and the lower head. A fatigue crack growth analysis is performed on the most critically stressed location in each region. Initial flaw sizes are assumed which are conservative upper bounds of the types of flaws which could exist in the hardware. Crack tip stress intensity factors are estimated using the well-known continuous surface flaw expressions, after linearizing the thermal and pressure stress distributions through the thickness of the vessel. An estimate of the degree of conservatism introduced by these two major approximations is included. Fatigue crack growth data from various sources were used. The sensitivity of the data to such variables as temperature, irradiation, and biaxiality is discussed. (auth)

4607 GENERAL ELEVATED TEMPERATURE EFFECTS. Corum, J. M. (Oak Ridge National Lab., TN); Goldhoff, R. M.; Placek, R. J. pp 447-458 of Pressure Vessels and Piping: Design and Analysis. Vol. I. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

The need for and complexity of developing a relationship between strain, stress, time, and temperature in order to predict and set design criteria for the creep deformation as well as elastic-plastic deformation of complex structures under variable loading and temperature conditions is reviewed. The present state of high-temperature design criteria and stress analysis, particularly as applied to nuclear vessels and piping, is discussed. (LCL)

4608 REVIEW OF THE INTERACTION OF CREEP AND FATIGUE. Ellison, E. G. (Univ. of Bristol, Eng.). pp 512-533 of Pressure Vessels and Piping: Design and Analysis. Vol. I. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

Many components in supersonic aircraft and modern power plant operate under cyclic conditions at increased temperatures at which creep processes also occur. Solving associated material problems depends, to a major extent, on understanding the various factors influencing behavior, such as the effect of stress or strain cycling, dwell periods, temperature, notches, environment, multiaxial stress, ductility, and the effect of prior testing on subsequent endurance. The various methods of testing are briefly described and the mode of failure where there is interaction between creep and fatigue is discussed. Methods for predicting deformation and life are also presented. Finally, the review concludes with suggestions for future work. (auth)

4609 PRESSURE VESSELS AND PIPING: DESIGN AND ANALYSIS. A Decade of Progress. Volume Two. Components and Structural Dynamics. Bohm, G. J.; Cloud, R. L.; Hsu, L. C.; Pai, D. H.; Reedy, R. F. (eds.). New York; American Society of Mechanical Engineers (1972). 834p. $35.00.

Forty-two papers on the design and analysis of pressure vessel components and piping are presented. A separate abstract was prepared for each of 3 papers. Two papers appeared previously

in NSA as 25:39277 and 25:41983. The remaining 37 papers are not within the scope of NSA. (LCL)

For abstracts of individual papers see: 4610 through 4612.

4610 SEISMIC ANALYSIS OF PRIMARY PIPING SYSTEMS FOR NUCLEAR GENERATING STATIONS. Berkowitz, L. (Franklin Inst., Philadelphia). pp 1191-1210 of Pressure Vessels and Piping: Design and Analysis. Vol. II. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

A seismic analysis of primary piping systems, including major components such as steam generators and primary coolant pumps, is presented. Examples of the analysis of typical, large, complex systems by lumped-mass mathematical model representations are given. Dynamic coupling of the piping system with shielding or containment structure is considered. The advantages and disadvantages of response-spectra, time-dependent, and spectral-density inputs are discussed. A step-by-step procedure for determining the seismic response to response-spectra inputs is summarized. The theoretical basis for computing the response to translatory as well as rocking motion of the base is given. Also, an example of computer results for response-spectra input is given. (auth)

4611 IMPACT BETWEEN CONTINUOUS STRUCTURES. Nahavandi, A. N. (Univ. of Vermont, Burlington); Bohm, G. J. pp 1211-1234 of Pressure Vessels and Piping: Design and Analysis. Vol. II. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

The dynamic response of continuous structures impinging on each other is determined by direct numerical integration of the differential equations for a linear or nonlinear impact situation. The equation of motion of structures, including the effects of shear deformation and rotary inertia is expressed in spatial finite difference form and integrated temporally to determine deflection as a function of time. The deflection curves are determined for a system of two similar and two dissimilar vertical beams excited at the top and striking each other at the bottom. This two-beam system simulates structural components having a small clearance and impinging on each other under seismic excitation, flow-induced vibration, or other forcing functions. The time variations of beam-end displacements reveal that differences in the elastic characteristics of the structures may lead to severe impact between the structure during a simulated forced excitation. Parametric studies are carried out to determine the effects of clearance gap variation between structures on the magnitude of the impact force. A numerical stability analysis is performed and a criterion for the convergence of the numerical solution is developed and proved to be satisfactory for all cases studied. (auth)

4612 SEISMIC DESIGN CRITERIA FOR NUCLEAR REACTOR FACILITIES. Newmark, N. M.; Hall, W. J. (Univ. of Illinois, Urbana). pp 1414-1427 of Pressure Vessels and Piping: Design and Analysis. Vol. II. Bohm, G. J. (ed.). New York; American Society of Mechanical Engineers (1972).

Based on a review of the seismic resistance designs of a number of nuclear reactors in the United States and on independent studies, the criteria applicable to the seismic design of nuclear reactor facilities are considered. The criteria described include the selection of the earthquake hazard, ground motions, response spectra, methods of dynamic analysis, methods of designing for fault motion, and a number of special topics. The discussion includes consideration of the relative importance of margins of safety and of applicable stress and deformation levels for facility structures and equipment. (auth)

4613 QUANTITATIVE APPROACH TO SITE EVALUATION. Tveten, U. (Institutt for Atomenergi, Kjeller, Norway). (1973). vp.

From symposium on principles and standards of reactor safety; Juelich, Germany (5 Feb 1973).

A calculation method is proposed that gives a good basis for comparisons. Instead of calculating the meteorological diffusion of released activities using standard meteorological conditions, concentration probabilities are calculated, taking all meteorological data pertinent to the site into account. The probabilities of finding concentrations above a certain limit in various directions and distances from the reactor are calculated, and this is linked to the population distribution. The concentration limit may be chosen to correspond to a level below which the probability of a certain harmful radiation effect becomes small. The calculated probabilities will then directly correspond to the occurrence of this effect, and when the population distribution is taken into account, it may yield the total effect of a certain type on the population. The sum of the products of probability times population may serve as a type of "quality factor." It refers to one certain type of accident, but the method may be extended to cover a number of different types of accidents. The "quality factor" will not correspond to the population dose. Only the occurrence or nonoccurrence of a certain effect is of interest. The quality factor is used to prepare a priority list of alternate power reactor sites from an accident point of view. (GF)

4614 SITING OF NUCLEAR POWER STATIONS. Cobian Roa, J. M. Evanston, IL; Northwestern Univ. (1972). 78p. University Microfilms Order No. 73-10,204.

A systematic approach is described for determination of optimum sites for nuclear power reactors within a given region. The factors considered are: (1) Accident probabilities and effects; (2) Radiation impact on population and environment; (3) Transmission and distribution costs; (4) Thermal discharge impact and cooling costs; (5) Land costs. For radiological impact caused by radionuclides and radiation, two situations are examined. Firstly, the radiological impacts of normal operating releases are computed utilizing meteorological dispersion models appropriate to annual, average effects. Here, maximum individual doses, and total doses to the regional population are calculated. Secondly, the consequences of accidental releases are computed utilizing standard meteorological dispersion methods. For each site, four accident parameters are computed: maximum individual doses; total dose to the low population zone; total dose to the regional population; and maximum point dose. A mesh of 81 squares about each site is used for low population zone computations. A mesh of squares about each site is used for dose computations to regional populations. Present mesh areas are 2 km squares, with up to 12,350 sites considered simultaneously in a given geographical region. A procedure for the comparison of the different environmental and economical factors is developed, and, on this basis, optimum areas for nuclear power stations sites are recommended for a more detailed study. This procedure can be applied, generally, where data are available. For illustration it is applied to the Northern part of Illinois, in a section of 260 × 190 km in size. (Diss. Abstr. Int., B)

Reactor Theory and Calculation

Refer also to abstracts 4021 and 4542.

4615 (AI-AEC-13076(Vol.2)) SELECTED COMPUTER CODES AND LIBRARIES. Volume II. APC: A Multigroup Transport Buckling Iteration Code. Bost, D. S. (Atomics International, Canoga Park, Calif.). 2 May 1973. Contract AT(04-3)-701. 144p. Dep. NTIS $3.00.

APC and APC II are both buckling (B^2) or leakage (DB^2) iteration codes for reactor calculations based on the one-dimensional transport theory code, ANISN. In APC, a uniform composition (single material) must be specified for all core zones. In APC II, the composition in core zones may be different and options for flux and importance weighting of the different compositions are provided. In both codes, two complete ANISN problems are specified. These two problems make up the case. The two problems are processed alternately transferring B^2 or DB^2 from each to the other until the results are mutually consistent. Termination of a case is controlled by convergence criterion on k_{eff} and leakage or by limiting the number of times the problems are processed (number of passes). Maximum execution time (CPU time) may also be used to terminate each problem or the case. Although a B^2 or DB^2 iteration case must be a k calculation, APC and APC II may both be used to run single ANISN type problems. (auth)

4616 (AREAEE-153) NUMERICAL FORMULATION OF MULTIGROUP AND DISCRETE S_N METHODS FOR REACTOR ANALYSIS. Nassar, S. F. (Atomic Energy Establishment, Cairo (Egypt). Reactor and Neutron Physics Dept.). 1972. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

A simple discrete difference approximation has been used to formulate the basic equations of the one-dimensional and two-dimensional multigroup diffusion techniques for plane, cylindrical, and spherical geometry. The discrete S_N method in spherical geometry has been treated similarly. A step by step procedure by which these basic equations can be coded for reactor numerical analysis is outlined. (auth)

4617 (AREAEE-158) LEGENDRE MOMENTS OF NELKIN'S KERNEL FOR WATER-DESCRIPTION OF KERNEN-CODE. Nassar, S. F.; Abul-Ela, E. (Atomic Energy Establishment, Cairo (Egypt). Reactor and Neutron Physics Dept.). 1972. 40p. Dep. NTIS (U. S. Sales Only) $4.00.

The presence of water as a component of reactor constituents makes reactor analysis difficult due to its complicated scattering kernel. One of the most sophisticated models that describes this

kernel is the Nelkin's model. Data of the transfer cross-section according to this model are not available in literature. The first four Legendre moments of Nelkin's scattering kernel were obtained. The data for each moment are listed in the form of (50 × 50) scattering matrix corresponding to the 50 energy groups used in the analysis. These results are obtained by coding a FORTRAN program "KERNEN" for compilation by ICL-1905E. The program can be also used for the heavy gas model which is described. (auth)

4618 (JAERI-M-4757) NEW METHOD OF REACTIVITY ESTIMATION BASED ON THE OPTIMAL ESTIMATION THEORY. Shinohara, Y.; Oguma, R. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 69p. (In Japanese).

A new method of dynamic reactivity estimation principally based on the modern optimal estimation theory was developed. Transient characteristics of the estimation process were investigated by simulation on a hybrid computer and the results were confirmed by the experiment on the semi-homogeneous critical assembly (SHE). An optimal estimator was designed and simulated on an analog computer. The reactivity estimator based on the modern theory was found to have good noise-stability and will be useful for reactivity monitoring, optimal reactor control, etc. (auth)

4619 (RT/FI-(72)44) BRINGING UP TO DATE, USING, AND CONTROLLING THE MULTIGROUP CROSS SECTION LIBRARY FOR FAST REACTOR CALCULATIONS. Cosimi, M.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy). Divisione Affari Internazionali e Studi Economici). 26 Sep 1972. 79p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.00.

Five multigroup cross section sets (ABBN type) are presented in a unified format. Some checks based on systems which are representative of the PEC reactor are also presented. (auth)

4620 (RT/PROT-(72)41) SOTRAN: UNIVAC 1108 PROGRAM FOR CALCULATION OF POWER TRANSIENTS IN A PULSED NUCLEAR REACTOR. Palma, F.; Sardone, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 Dec 1972. 71p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.75.

A preliminary version of a code to calculate core thermal transients due to nuclear power variations in a pulsed reactor is described. Classical kinetics with a neutron source to describe actual power and kinetics to describe an average power are contained in the code. (tr-auth)

4621 EXPERIMENTAL DETERMINATION OF THE EFFECTIVE RESONANCE INTEGRAL AND THE DOPPLER EFFECT OF UO_2 COATED PARTICLE FUEL. Corbo, G.; Haemers, L.; Tassan, S. (CCR-EURATOM, Ispra, Italy). Energ. Nucl. (Milan); 20: No. 1, 44-48(Jan 1973).

The effective resonance integral and the Doppler effect for UO_2 coated particle fuel in a 1/E neutron spectrum were measured by the activation technique, following irradiation of test-elements at a fuel vacant position on the core center of the D_2O moderated ECO critical facility. The experimental results obtained were in good agreement with theoretical values calculated by the ZUT-TUZ codes. A semi-empirical formula for the Doppler coefficient β, with range of validity extending over that of the current expressions, was derived and tested for resonance integrals in the range from 12 to 150 b. (auth)

4622 TECHNICAL ASPECT OF FAST REACTOR FEEDBACK EFFECTS CALCULATION. Part II. Hydrodynamic Effects. Pfann, J.; Dusek, J. (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 2, 38-42(Feb 1973). (In Czech).

A method for fast reactor temperature feedback effects calculations is presented. Expressions for reactivity feedback calculations for a rather accurate model of active core deformation under the conditions of unequal distribution of hydrodynamic pressure are presented, supposing the basic reactivity coefficients have been already computed. Particular interest is turned to the reactivity contribution which results from the fuel element bending, caused by hydrodynamic forces. Generally derived expressions are adapted for some conditions which can be often met, in the form which can be readily used. The formula for reactivity change due to the fuel element bend is valid even for intense perturbations of power level or coolant flow, presuming a sufficiently slow process. (auth)

4623 NEUTRON BEHAVIOR IN CLUSTER-TYPE FUEL LATTICES. II. Theory and Analysis of Experiment. Yamamoto, K.; Kurihara, K.; Ishida, M.; Matsuoka, K.; Wajima, J. T. (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 12, 705-715(Dec 1972).

A multigroup method of calculation is presented for describing the neutron behavior in a cluster-type fuel lattice. It solves the integral transport equation by a semi-analytical method proposed in a previous paper for calculating collision probabilities in the lattice of a clustered fuel element. Using only fundamental nuclear data, it gives space and energy dependent neutron flux. The method has been programmed for HITAC-5020F (computer code CLUSTER-III). The accuracy of the method has been tested by comparing the calculation with experiment. The lattices are 28-pin clusters of UO_2 or $PuO_2 + UO_2$ fuel pins, with heavy- or light-water moderators and with light-water coolant containing void ratios. The quantities studied are micro-parameters, reaction distributions in energy and space, thermal disadvantage factors and the multiplication factors. It is found that the calculated results are generally in good agreement with experiment, typically within 10% for micro-parameters and thermal disadvantage factor, and within 1% for the multiplication factor. (auth)

Reactor Components and Accessories

Refer also to abstracts 2504, 2518, 3319, 3355, 3358, 3368, 3369, 3377, 3384, 3389, 3397, 3401–3404, 3407, 3410, 3411, and 4604.

4624 (RDT-E-1-31-T(4-73)) CARBON STEEL ISOLATION VALVES. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 21p. RSO.

Standards for carbon steel, air-spring operated, globe type isolation valves for quick closing applications in steam piping systems that penetrate containment vessel pressure boundaries in a nuclear energy system are presented. (auth)

4625 (RDT-E-10-4-T(3-73)) ACCUMULATORS, PRESSURE VESSEL, CLASS 2. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Mar 1973. 14p. RSO.

This standard delineates the requirements for materials, design, fabrication, testing, inspection, shipping, and certification of accumulator vessels. (auth)

4626 SHIELDING ELEMENTS FOR NUCLEAR REACTORS. Schweigert, F.; Schroeder, P. (to Siemens AG). German Patent 2,049,570. 20 Apr 1972. 3p. (In German).

The shielding elements described have a prismatic cross section and consist of an inherently, stable outer wall and, a sand-like inner body. The outer layer is about 10 mm thick and is made of barium sulfate powder molded with water glass containing 4 to 7% water, whereas the inner body consists of barium sulfate powder with a water content of about 0.5%. The cylindrical outer walls of the elements as well as the two front walls are molded separately, with this outer casing then being filled with stones and sand and subsequently sealed with water glass. The elements are then covered with a layer of synthetic resin (epoxy resin). (GF)

4627 SEAL FOR ROTATABLE COVERS OF NUCLEAR REACTORS. Jansing, W.; Rohrs, H.; Rothfuss, H. (to Interatom Internationale Atomreaktorbau GmbH). U. S. Patent 3,717,352. 20 Feb 1973. Priority date 21 Apr 1969, Federal Republic of Germany (F. R. Germany). 4p.

A seal for a large rotatable cover of a nuclear reactor which contains a protective gas and is cooled with sodium is described. The cover is formed of a radially outer rotatable cover portion and a radially inner cover portion mutually connected by a number of peripherally distributed screws. The reactor has a flanged opening closable by the cover, comprising a removable outer ring surrounding the outer rotatable cover portion and threadedly secured to the flange of the reactor. A pair of spaced-apart inflatable hollow sealing rings surround the outer cover portion. A blocking gas connection is located in the space between the sealing rings for supplying blocking gas to the space. A layer of tetrafluorethylene is coated on the hollow sealing rings in the outer ring. An additional sealing member is located below the inner cover portion. The screws connecting the inner and outer cover portions are adjustable for lowering the inner portion into sealing engagement with the additional sealing member. (Official Gazette)

4628 IMPROVEMENTS IN OR RELATING TO THERMAL INSULATION. Hayden, O.; Hind, J. R. (to United Kingdom Atomic Energy Authority). British Patent 1,300,390. 20 Dec 1972. Filed date 12 Aug 1969. 7p.

A system of thermal insulation is described that is claimed to be suitable for application to nuclear reactors. It comprises parallel-extending metal sheets welded together along lines to define a multiplicity of closed shapes, so as to afford gas filled compartments of substantial depth. Each compartment is provided with barrier means for obstructing convection flow of gas. Various alternative constructions are described. (UK)

4629 METHOD FOR INTRODUCING A PRESTRESS TO A CONCRETE STRUCTURE. Hiraga, K. I. (to Taisei Kensetsu Kabushiki Kaisha). British Patent 1,305,629. 7 Feb 1973. Filed date 15 Sep 1970. 9p.

A method is described for introducing prestress into a concrete structure of circular section, such as a nuclear reactor pressure vessel. Wedge members are slidably located on an outer peripheral face of the structure, this face being inclined so that, on sliding the wedge members along it, the outer surfaces of the members can be moved radially outwards relative to the axis of the structure. Jack means are provided at the outer periphery of the structure for slidably displacing the wedge members, and tensioning members are wound circumferentially about the structure so as to engage the outer surfaces of the wedge members. The tensioning members are stretched around the structure by operating the jack means to cause the wedge members to slide along the outer inclined face of the structure, thus introducing prestress into the structure. The outer surface of the structure on which the wedge members are located may be of frusto-conical form, and recessed channels may be provided in the wedge members for fitting the tensioning members. (UK)

4630 POWER REACTOR DEVELOPMENT AND PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Davidson, I. (United Kingdom Atomic Energy Authority, Warrington, Eng.); Jaeger, T. A. pp 15-28 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

The advantages of prestressed concrete reactor vessels especially in comparison with steel pressure vessels are discussed. The natural economic trend toward large unit sizes of power reactors favors concrete pressure vessel due to possible vessel dimensions in combination with internal pressures, freedom of shape, and increased safety. (auth)

4631 RELEVANCE OF CONCRETE PROPERTY RESEARCH TO PRESSURE VESSEL DESIGN. Browne, R. D.; Blundell, R. (Taylor Woodrow Construction, Ltd., Southall, Eng.). pp 69-102 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

A resumé is presented of the important factors in the design of pressure vessels which must be appreciated by the concrete research worker in his future work. The object of the paper is to indicate the type of research needed in the process of current pressure vessel design. (20 references) (auth)

4632 PRACTICAL APPROACH TO THE DESIGN PHILOSOPHY OF PRESTRESSED CONCRETE REACTOR VESSELS: THE IMPORTANCE OF CONCRETE PROPERTIES TO PCRV DESIGN. Plaehn, J. L. (Gulf General Atomic, Inc., San Diego, CA). pp 103-138 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit, American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

The history of PCRV technology is briefly reviewed, and reasons are given why this technology still demands much attention. The interrelationship between PCRV design and concrete properties is then outlined. The structural system of PCRVs under operating conditions and ultimate strength conditions is described with some reflection on the use of bonded and unbonded prestressing systems and on the effect of liner leakage. Then the PCRV design and safety philosophy is discussed in terms of serviceability and safety requirements. Requirements for linearly elastic response of the PCRV to short-term pressure loads and the importance of temperature effects are discussed in relation to serviceability requirements. The need to specify the maximum pressure to which the PCRV will be subjected is examined, and design and material uncertainties and their relationship to safety factors are outlined. The significance of concrete properties for the PCRV design as related to elastic, creep, and ultimate load analyses is discussed, and design-oriented research needs are outlined. (auth)

4633 PCRV, PROBLEMS OF CALCULATION, MATERIAL PROPERTIES, AND EVALUATION OF RESULTS. Hofmann, H. H. pp 141-157 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

Computer technology has presented the opportunity for approximation techniques and iterative procedures replacing the traditional systems of differential equations in stress analysis. Possibilities of structural analysis (material properties) which are necessary for assessment of structural behavior are presented. (auth)

4634 DISCUSSION ON FINITE-ELEMENT ANALYSIS OF PRESTRESSED CONCRETE REACTOR VESSELS. Argyris, J. H.; Buck, K. E.; Grieger, I.; Willam, K. J. pp 181-201 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

A discussion is presented on the state-of-the-art of finite-element analysis particularly as it applies to the analysis of reactor vessels. The matrix displacement method using the special computer language ASKA as well as a more general approach using FORTRAN IV is presented. 12 references. (auth)

4635 EXTERNAL POLYGONAL PRESTRESSED REINFORCEMENT WITH MULTIPLE INTERMEDIATE ANCHORAGES. Muehe, L. (Phillipp Holzmann AG, Frankfurt am Main). pp 221-234 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

Prestressed concrete pressure vessels are usually cylindrically shaped and hence are hoop prestressed. Presently the hoop prestressing is carried out on the outer face. Construction procedures, inspection, and corrosion protection for prestressing wires are described in detail, followed by the construction method of a model concrete vessel applying the prisma prestressed reinforcement method. The concentrated tensile forces that can be achieved by using the external circumferential prestressed reinforcement are discussed. (auth)

4636 CAPACITY OF PRESTRESSED CONCRETE PRESSURE VESSELS TO RESIST SHEAR. Garas, F. K.; Langan, D. (Taylor Woodrow Construction, Ltd., Southall, Eng.). pp 235-266 of Concrete for Nuclear Reactors. Vol. I. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From meeting on concretes used in nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.1).

Reported are experimental studies into the behavior of deep restrained concrete elements under the action of high shear loads. The concrete elements were restrained by biaxial field stresses of varying intensities and gradients. (auth)

4637 ASSESSMENT OF INSTRUMENTATION FOR USE IN PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Czaika, N. (Bundesanstalt fuer Materialpruefung, Berlin). pp 1421-1438 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

An analysis of the instrumentation (transducers, intercircuits, computing devices, and recording instruments) used in prestressed concrete reactor pressure vessels is presented. (68 references) (auth)

4638 CONCRETE BEHAVIOR UNDER COMBINED STRESSES UP TO FAILURE; TEST RESULTS ON SMALL-DIMENSION PRESTRESSED CONCRETE PRESSURE VESSEL MODELS. Scotto, F. L. (Ente Nazionale per l'Energia Elettrica, Rome). pp 1471-1511 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

Results are presented on the behavior under combined stresses of typical sections related to the models of vessel components in prestressed concrete (cap slabs; cylindrical wall section) during the pressurization up to structural collapse. The significance of the analysis of concrete structure behavior by means of small-dimension model structures is pointed out, and the contribution of these studies to a better understanding of the problem is discussed. (auth)

4639 METHODS OF INFORMATION EXCHANGE IN THE FIELD OF PRESTRESSED-CONCRETE REACTOR PRESSURE VESSELS. Benzler, H. (Commission of the European Communities, Brussels). pp 1597-1619 of Concrete for Nuclear Reactors. Vol. III. Kesler, C. E. (ed.). Detroit; American Concrete Institute (1972).

From international seminar on concrete for nuclear reactors; Berlin, F.R. Germany (5 Oct 1970). See CONF-701007-(Vol.3).

A synopsis of the present methods of information exchange in the field of prestressed concrete reactor pressure vessels, particularly as handled by the Commission of the European Communities, is presented. Suggestions are also presented to aid the transfer of information. 14 references. (auth)

Reactor Fuels

Refer also to abstracts 3017, 3020, 3024, 3025, 3027, 3029, 3034–3045, 3047, 3049–3054, 3089, 3090, 3092, 3159, 3170, 3429, 3433, 3435–3437, and 4621.

4640 (EURFNR–1048) CALCULATION OF STRESSES AND STRAINS IN DOUBLY CONNECTED PRISMATIC BODIES WITH SAMPLE CALCULATIONS FOR AN AXIALLY FINNED FUEL CLAD. Krieg, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Oct 1972. 58p. (KFK–1665). Dep. NTIS $5.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The stress distribution of elastic prismatic bodies with uniform loads along their axis is described by a partial differential equation. One way of solution is the representation by an infinite power series, the homogeneous parts of which are known from literature. The particular solution, however, has to be formulated in a suitable way, since a problem with given initial strains has to be solved. For instance, thermal strains represent such initial strains. In the homogeneous parts of solution certain constants appear, which are determined by the boundary conditions and possibly by the Michell conditions. For a given accuracy the calculation of these constants reveals severe numerical difficulties in cases, where the cross section contours significantly differ from a circle. The successful treatment of this problem is described. The analytical results are compared with photoelastic experiments. On the basis of this linear elastic treatment the solution is extended to allow for nonlinear behavior (creep). An incremental procedure is employed, so that for each small time step an elastic stress distribution as well as corresponding increments of creep strains can be calculated. The initial strains for an elastic stress solution at a certain time are represented by the creep strains accumulated up to this time. Applying the described theory, two computer programs were developed: EVA1 (linear elastic material) and EVA2 (nonlinear material). Both programs are particulary suited for the stress analysis of nuclear reactor fuel pins with integrated axial ribs. Various case studies are included showing the effects of internal pressure, thermal strains, swelling as well as irradiation induced creep. (auth)

4641 (IFA-FR-96-1972) OBSERVATION OF A CLADDING FAILURE BY FISSION PRODUCT GASES FROM THE COOLANT. Vidrighin, R.; Ionescu, E.; Alexan, Z. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

Fission gases may be present in a reactor from the fission of uranium which is a natural impurity in the structural materials of the reactor, from constant diffusion through the fuel can, or as a result of opening of some pores in the can. In the first two cases the gases present in the reactor under normal operational conditions add relatively constant activity to the background activity of the coolant water of the reactor. This is found by means of the radiochemical analyses both of the coolant water and of the gas mixture from the reactor degassing system. Such analyses are necessary for prompt detection of failed elements. (auth)

4642 (KFK-1727) EVALUATION OF THE INVESTIGATION RESULTS ON THE IRRADIATED UO_2-PuO_2 FUEL RODS OF THE TEST SERIES FR 2-4a. Dienst, W.; Goetzmann, O.; Kleykamp, H.; Ondracek, G.; Schulz, B.; Zimmermann, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jan 1973. 125p. (In German). Dep. NTIS (U. S. Sales Only) $8.25.

In the capsule-irradiation test series FR 2-4a, short UO_2-PuO_2 fuel rods (80 mm fuel length) of 7.4 mm outer diameter were irradiated at mean rod powers from 350 to 500 W/cm to from 10 to 95 MWd/kg (U + Pu) burnup. To calculate the fuel temperature profile, a thermal analysis was made assuming constant heat source density. The influence of fuel porosity was taken into consideration. The amount of fission gas was measured in 3 steps as released fission gas, fission gas retained in large bubbles and fission gas retained in small bubbles and crystal lattice sites. This was done by piercing the fuel rods, by grinding the fuel, and by chemical solution of the powdered fuel. The void volume distribution in fuel rod cross-sections was investigated by measuring crack widths, central hole diameters, and porosity. Porosity was measured by an electronic micrograph analyzer. Fission-product compound composition and distribution as well as plutonium redistribution were examined by microprobe analysis. Finally, the results are given of a systematic examination of all ceramographic micrographs of the test fuel rods with a view to the reactions between the cladding (stainless austenitic steel material–No. 4988) and the fuel that could be observed. The chemical compatibility between the UO_2-PuO_2 fuel and the cladding proved to be difficult to judge because of the changing thermal conditions during irradiation. (GF)

4643 INSTRUMENTED CAPSULE FOR IN-REACTOR FUEL CREEP STUDIES AT HIGH FISSION RATES. Robinson, R. A.; Basham, S. J.; Perrin, J. S. (Battelle Columbus Labs., OH). Nucl. Eng. Des.; 24: No. 2, 242-249(1973).

An instrumented capsule for in-reactor creep studies of ceramic nuclear fuels at high fission rates has been designed, fabricated and successfully operated. The capsule contains a device for loading the creep specimen in compression from 0 to 13,000 psi. The temperature is adjusted by means of both internal electrical heaters and a gas gap. The deformation of the specimen during creep is continuously measured by means of a constant gas flow, variable orifice device. Creep studies have been conducted in the Battelle Research Reactor on UO_2-22 w/o PuO_2 in the temperature range of 350 to 600°C, the stress range of 4000 to 8000 psi and the fission rate of 3.8×10^{13} fissions/cm^3 sec. The creep rate under these conditions was found to be substantially increased as a result of the fission process. (auth)

4644 DYNAMIC LOAD FACTORS FOR PLASTIC DEFORMATION OF HEXAGONAL SUBASSEMBLY DUCTS. Youngdahl, C. K.; Rosenberg, G. S. (Argonne National Lab., IL). Nucl. Eng. Des.; 24: No. 1, 105-109(1973).

The dynamic plastic deformation of a hexagonal subassembly duct subjected to an internal step pulse is computed for various wall thicknesses and pulse magnitudes. The results are compared to the corresponding plastic deformations of a duct loaded by static internal pressures of the same magnitudes as the step pulses. It is shown that the dynamic deformations exceed the static deformations by factors of 1.7 to 2.0. The results for deformation across flats cover a range of several wall thicknesses for pressures as high as twice the yield load of an undeformed can. The time duration of the dynamic response is also determined. (auth)

4645 FUEL ASSEMBLY FOR A NUCLEAR REACTOR USING ZIRCONIUM ALLOY CLAD FUEL RODS. Mayers, J. B.; Kmonk, S. (to Westinghouse Electric Corp.). U. S. Patent 3,719,560. 6 Mar 1973. Filed date 29 Apr 1969. 12p.

Zirconium alloy structural materials for fuel rods are desirable in nuclear fuel assembly construction due to their low neutron absorption cross section properties. However, zirconium alloys are difficult to utilize due to their inability to be welded with other commonly-used fuel assembly construction materials such as Inconel or stainless steel and their thermal expansion coefficient is significantly smaller than the Inconel or stainless steel alloys commonly-used. The latter characteristic may result in buckling of the fuel assembly in a changing thermal environment. To obviate these difficulties in utilizing fuel rod cladding and/or fuel assembly cans of zirconium alloy with other structural elements such as a spacer grid formed from other materials, provisions are made for: a fuel assembly construction having a zirconium alloy enclosure including means for attaching structural elements such as nozzles or grids of other materials, and a stainless steel enclosed fuel assembly having zirconium alloy clad fuel rods. Means for permitting relative movement of the fuel assembly parts due to differences in the thermal expansion rates of elements in the fuel assembly are described. (Official Gazette)

Reactor Control Systems

Refer also to abstracts 2224 and 2774.

4646 (CEA-CONF-2141) IMPORTANCE OF OPERATIONAL RELIABILITY DATA FOR AN ESTIMATE OF THE RELIABILITY OF A COMPLEX SYSTEM. Carnino, A.; Pavret de la Rochefordiere, A.; Quenee, R. (Commissariat a l'Energie Atomique, Paris (France)). 1972. 12p. (In French). (CONF-720979-1). Dep. NTIS (U. S. Sales Only).

From national conference on reliability; Perros-Guirec, France (20 Sep 1972).

The case of a reactor functioning at its normal power, but producing a reduced voltage across the network is considered. If this reduction in potential persists beyond 2 seconds, the reactor has to be shut down. The fall of the control rods, which shuts down the reactor, is controlled by the appropriate emergency circuits. An estimation was made of the probability of the correct functioning of these circuits during a time lapse of between 2 and 8 seconds after the occurrence of the incident. The logic diagram was established and the probability of the components failing was estimated. In the absence of usable data concerning the reliabilities of French materials, foreign data were used. Two estimations of the reliability of the circuits were made using a computer: the first estimation used American data; the second estimation

used data from a British data library. The results obtained are compared. The sensitivity of the overall reliability of the system to the probability of the correct functioning of certain sub-systems and components was tested. (FR)

4647 (EURFNR-1062) SYSTEMATIC ERRORS AND POSSIBILITIES OF CORRECTION IN INVERSE KINETIC CONTROL ROD CALIBRATIONS. Walze, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Nov 1972. 72p. (KFK-1701). Dep. NTIS $5.75.

Work performed under United States-Euratom Fast Reactor Exchange Program.

A survey is presented of the most important systematic errors which appear when reactor shim rods are calibrated by means of the continuous run method. Possible corrections are described. Rod calibrations at the fast zero power critical facility SNEAK (Schnelle Null-Energie-Anordnung Karlsruhe) serve as examples. The influences of the integrating time interval, the measuring techniques, the additional neutron source, the reactor kinetic parameters and the delayed gamma flux are either negligible or can be corrected easily. Up to now this was not true for the large errors according to space dependent higher harmonics of the neutron flux distribution. This kind of systematic error was a big disadvantage of the continuous run method compared with the more conventional stable period measurement, because there were only correction procedures for stepwise reactivity changes. A new iterative method is described, which can also be applied to slow, that is, not stepwise reactivity changes as they appear when a shim rod is calibrated continuously. For rod calibrations at SNEAK, this method gave satisfying results. (auth)

4648 (GEAP-13908) ALTERNATE SHUTDOWN SYSTEM CONCEPT SELECTION. McKeehan, E. R.; Shawver, B. M.; Taft, W. E. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jan 1973. Contract AT(04-3)-189. 149p. Dep. NTIS $5.45.

The recommended reference and fall-back Alternate Shutdown System designs are presented. The current selection criteria are included and the technical justification and bases for the selection are given. The reference concept has a latch that releases the control element for insertion into the core as assisted by the existing core pressure drop forces. The fall-back concept has a similar insertion assist, but the control element is held out of the core by high pressure flow supplied by a control pump located outside the reactor vessel. De-energizing the control pump inserts the control element. Additionally, a liquid absorber system and an articulated element are discussed. These systems explore the advantages and disadvantages of radically different concepts; however, neither met all the design requirements and were rejected. (auth)

4649 (KFK-1735) SAFETY ASSEMBLIES FOR FAST SODIUM COOLED REACTORS. Jacobi, S.; Lenhardt, H.; Schneider, R. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Feb 1973. 85p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

Described are several possibilities of implementing, by a balanced relationship between safety and availability, a Multi-Input-Protection System (MISS) using computers for the monitoring of each fuel element in a SNR. The reasons for the essential requirements to the protection system are outlined. In combination with the coexisting conventional protection system, the use of diverse system redundancy can be shown to meet the most stringent safety requirements. Referring to presently available failure-rates of system components, using an approximation, it is shown that an MTBF-value of about 10 years can be attained for a 2 out of 3-system. A basic solid state shut-down circuit including a coincidence logic with an all-over dynamic system check is proposed for a 2 out of 3-system which operates at a checking frequency of $f > 1/1.5$ s for failures in the unsafe direction. Another unit is proposed which deals with the problem of synchronizing a 2 out of 3-computer system, because a synchronized protection system is considered to minimize the reaction time (1.5 sec). On the basis of flexible programming, three variations of input data combinations resulting in shut-down signals are discussed. Other additional safety requirements as well as sensor availability can be taken into account through additional variations. A program review is given leading to an estimated minimal core memory capacity of 12 k-words. Additional redundant protection systems with computers have been studied to overcome difficulties arising from MTBF's of detectors in the same range as estimated for the electronic system or a desired longer MTTR. Polymorphous structures may overcome some availability problems coming from the detectors as well as from the computer system itself.(GF)

4650 (RDT-C-1-1T(1-73)) INSTRUMENTATION AND CONTROL EQUIPMENT GROUNDING AND SHIELDING PRACTICES. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 49p. RSO.

The standard provides the requirements for grounding and shielding of instrumentation and control circuits of reactor facilities. Grounding and shielding practices which will insure effective noise rejection in the instrumentation and control (I&C) signal circuits are established. Recommended shielding and grounding methods, cable installation practices, and methods to be used for grounding and shielding specific types of signals are included. (auth)

4651 (RDT-E-6-26-T(4-73)) FABRICATION OF CONTROL ROD DRIVELINE FOR SODIUM COOLED REACTORS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Apr 1973. 22p. RSO.

Standards for the fabrication, quality assurance, packaging, and delivery of control-rod drivelines for sodium-cooled reactors are given. The control-rod driveline provides a positive connection between the control-rod drive mechanism and the control-rod absorber during reactor operation, a means to decelerate the control rod components following scram, and a double disconnect which permits uncoupling prior to refueling and coupling for resumption of reactor operation. (FS)

4652 (WCAP-8014) DIGITAL ROD POSITION INDICATION. Blanchard, A. E.; Calpin, J. E. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Energy Systems Div.). Dec 1972. 25p. Dep. NTIS $3.25.

A digital rod position indication system for Westinghouse pressurized water reactors is described. Improvements related to the digital detector system are discussed. The features of the system result in improved performance, reduced setup and calibration time, and reduced installation costs. (JWR)

4653 ADJUSTABLE SHAFT COUPLINGS. Jamieson, G. R. (to United Kingdom Atomic Energy Authority). British Patent 1,301,283. 29 Dec 1972. Filed date 1 Aug 1969. 3p.

Reference is made to mechanisms for facilitating adjustment of the relative rotational positions of coupled coaxial shafts while stationary, whether or not the shafts are subject to torque. The mechanism described comprises a pair of intermeshing toothed gears, one of which is fixed to one shaft, while the other is carried in bearings mounted in a housing on the other shaft. The drive between shafts is transmitted through the stationary gear teeth, and rotation of the second gear, by an independent input, is effective to adjust the relative rotational positions of the shafts. Means are provided on the coupling for indicating the relative positions, together with means for locking the shafts together. A preferred form of gearing is a worm and worm wheel, but other forms of skew gearing are suitable. An application is in nuclear reactor control mechanisms. (UK)

4654 CONTROL ROD ASSEMBLY FOR A NUCLEAR REACTOR. Marmonier, P.; Pflugrad, K. (to Commissariat a l'Energie Atomique). French Patent 2,118,852. 4 Aug 1972. Filed date 22 Dec 1970. 8p. (In French).

An assembly (control rods and sheath) for the control of fast liquid Na cooled power reactors is presented. A fixed sheath is used and the control rods are provided with an absorbent part. The sheath enables the rods to be manipulated and transported from a position with the absorbent part in the core (lower position) to a position with the absorbent part outside the core (upper position). The sheath is provided with holes for the input and output of the reactor coolant at positions both above and beneath the core. A bearing is situated in a position above the core between the control rod and the sheath. This bearing allows just enough play for the circulation between the sheath and the control rod of a negligible fraction of the coolant penetrating and leaving the sheath. (FR)

Nuclear Power Plant Economics

4655 (AEC-tr-7423) SYSTEMATIC RECORDING AND EVALUATION OF FAILURES. Fehndrich, W.; Feldmann, J.; Franzen, L. F.; Stoll, A. (Technischer Ueberwachungs Verein E. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). 1973. Translation of IRS-W-4. 50p. Dep. NTIS $4.50.

Comments on the "systematic recording and evaluation of failures" provide an overview of the related problems. The systematic recording of all pertinent information was used as the starting point. This data base would be collected primarily by the nuclear plant operators; however, additional subjects of interest for the consultant, the manufacturer, and the insurer must also be considered when these data are recorded. This will result in a collection of problems for people involved in the safe and economic development of nuclear energy. The flow of information must be controlled to ensure that it agrees with

the methods used within the plants; taking justified requirements into account. The uniform classification system was found to be helpful in the solution of technical problems. The available data indicate that certain specific points of view have been taken into account; it appears possible to consider other viewpoints also in the near future. Considerable practical experience was gained in some important sectors, underlining the value of systematic recording and evaluation of failures. (auth)

4656 (ORNL-4809) CONCEPT: COMPUTERIZED CONCEPTUAL COST ESTIMATES FOR STEAM-ELECTRIC POWER PLANTS. Phase II User's Manual. Bowers, H. I.; Reynolds, L. D.; DeLozier, R. C.; Srite, B. E. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 216p. Dep. NTIS $3.00.

The CONCEPT computer code package was developed to provide conceptual capital cost estimates for nuclear and fossil-fueled power plants. Cost estimates can be made as a function of plant type, size, location, and data of operation. Output includes a detailed breakdown of the estimate into direct and indirect costs according to the USAEC accounting system described in document NUS-531. Cost models are currently provided for single-unit PWR, BWR, and coal- and oil-fired plants. Work is in progress to provide cost models for single-unit HTGR and gas-fired plants and for two-unit plants. (auth)

4657 ENERGY IN THE FUTURE. The Role of Nuclear Fission and Fusion. Lewis, W. B. Proc. Roy. Soc. Edinburgh, Sect. A; 70: 219-223(1972).

For comfort the total future world population faces a limit. Three or more educated generations seem likely before the population growth will be checked. It seems prudent to envisage a world population of about 15 thousand million in a century or two. Their energy needs for food, water, warmth, clean air, locomotion and management of wastes may be assessed at 5 to 50 thermal kilowatts per capita. That amounts to 0.05 to 0.5% of the energy supply from the sun. Generating this amount by nuclear fission would cause no severe pressure on world resources of uranium and thorium for hundreds of centuries, if near-breeders such as CANDU reactors are used exploiting the uranium-thorium fuel cycle. Neither the cost of fuel supply nor of waste management to keep the environment unburdened by extra radioactivity need be as high as prices now paid for coal and oil. The addition of breeders or other means such as nuclear fusion or spallation for increasing the neutron supply would significantly lower the use of uranium and thorium but would not necessarily reduce the cost of power. (auth)

4658 CANADIAN PROJECTS CONCERNING THE DEVELOPMENT OF THE POWER ECONOMY UNTIL 1990. Arch. Energiewirt.; 26: No. 1, 1-3(1972). (In German).

A forecast is given on the expenditures for both conventional and nuclear equipment of Canadian nuclear power plants in 4 successive five year periods (1971 to 1990). The data are based on a pressurized heavy-water moderated and cooled reactor, type CANDU. Plans for installing a tide power plant, as well as for increasing electric power generation in Canada are reported. (GF)

4659 NUCLEAR POWER DEVELOPMENT AND ITS PROBLEMS IN JAPAN. Oomachi, S.; Minato, T.; Takaoka, Y. Arch. Energiewirt.; 26: No. 5, 234-238(1972). (In German).

The main problems of the establishment of nuclear power plants are briefly described and include: construction time, capital expenditure, reliability of fuel supply, site selection, integration into the power supply system, and availability. A comparison of the construction costs of conventional and nuclear power plants either in operation, under construction, or planned in Japan is given in tables. (GF)

4660 SECOND INDICATIVE NUCLEAR PROGRAM FOR THE EUROPEAN COMMUNITY. Energ. Nucl. (Paris); 14: No. 6, 435-451(Nov 1972). (In French).

The 2nd Indicative Nuclear Program of the European Community, which was prepared during the years 1970 and 1971 is valid up until 1985. Nuclear energy appears to satisfy the energy policy criteria of the Community: safety aspects; availability and cheapness of energy; protection of the environment. The role to be played by nuclear energy in the future production of electric power was studied. The final objective of the Indicative Program is the production of 100,000 MWe in 1985. The means at the Community's disposal for ensuring the construction of the necessary nuclear installations (light water reactors, high temperature reactors, fast reactors) are reviewed. The potential market available to industry is presented together with information about the investments that will have to be made. The conditions necessary for the realization of the program are discussed: freeing of markets, normalization of the construction and operation of installations and of the transport of radioactive substances, concentration of industries concerned with the construction of nuclear plants and those concerned with the fuel cycle, safety aspects of nuclear fuel supplies, and the supplying of information to the public on the environment. The contributions of nuclear energy to electric power production in the years 1985 up to 2000 are envisaged. The newly available means for energy production are evaluated (fast breeder reactors, high temperature gas reactors) together with the relative amounts of energy produced by these different means. (FR)

4661 FUTURE OF NUCLEAR ELECTRICITY PRODUCTION IN FRANCE. Cheret, Y. (Electricite de France, Paris). Develop. Ind. Sci.; No. 9, 2-7(Mar 1972). (In French).

Energy consumption is increasing rapidly in France and other industrial countries. After reviewing the first nuclear plant programs established between 1956 and 1958 the recent orientation towards enriched U-water reactors (Vith plan-supply of nuclear fuels) is given. Other nuclear plants being developed are investigated. Nuclear energy presents advantages in the field of economics, safety and environment. (FR)

4662 INVESTIGATION OF STRESSES IN MAIN CIRCULATION PIPELINES OF THE NOVOVORONEZH ATOMIC ELECTRIC POWER STATION. Dranchenko, B. N.; Prigorovskii, N. I. pp 183-208 of Issled. temperatur. napryazheniy. Moscow; Izdatel'stvo Nauka (1972). (In Russian).

Main results of tensometric investigations on models, test beds, and natural constructions are presented which were carried out when projecting and during the period of the nuclear reactor start-up at the atomic electric power plant. The pipeline characteristics in connection with the carried out investigation, the method of experimental investigation of deformations, stresses, and temperatures, and also the main investigation results under stationary and nonstationary operating conditions are examined. An analysis is presented of the main results of measurements in connection with a strength evaluation of pipeline components and characteristics of the stressed state of pipelines depending on operation conditions. Demonstrated applications of models and investigations of natural blocks made it possible to select the design and construction of main pipelines when accounting for developing stresses. (JPRS)

4663 REVISED LONG-RANGE PROGRAM FOR ATOMIC ENERGY DEVELOPMENT AND UTILIZATION. Kisaka, T. (Science and Tech. Agency, Tokyo). Gakujutsu Geppo; 25: No. 5, 320-325(Aug 1972). (In Japanese).

The long-range program for atomic energy development and utilization, prepared in April 1967, was revised in June 1972. The advance in nuclear power generation has been more than expected in the previous long-range program, consequently problems have arisen in fuel supply, siting, environmental safety, and waste disposal. In this revised long-range program, taking an extended view over the next 20 years, important policy and promotion plans on the development and utilization of atomic energy are presented for up to 1980. Its contents are as follows: fundamental idea for atomic-energy development and utilization; measures to be taken in the program, including the prospect of nuclear power generation, siting, fuel supply, and environmental safety; development of new power reactors, nuclear-powered ships, multipurpose reactors, nuclear fusion, and radiation utilization; and other aspects including basic research, training and education, information exchange, safeguard, and the atomic industry. (JA)

4664 PROSPECTS FOR UTILIZATION OF THE THERMAL ENERGY OF NUCLEAR REACTORS AT FERROUS METALLURGY PLANTS. Voskoboynikov, V. G.; Perlov, N. I.; Kurbatova, N. O.; Mel'nik, N. A. Stal; No. 11, 1052-1055(Nov 1972). (In Russian).

Based on a review of the literature and information materials, as well as studies and technical and economic evaluation, possibilities are analyzed of direct utilization of the thermal energy of nuclear reactors at metallurgical plants. Interest is being shown in this problem in Japan and West Germany, due to the low reserves of fossil fuel and its high price. In the USA, although nuclear power engineering has been broadly developed, the use of nuclear reactor heat in ferrous metallurgy is considered unfavorable, due to the lower cost of conventional fuel. Versions of the utilization of nuclear reactor heat at metallurgical plants of various structrues with blast furnaces and with direct iron reduction shops have been studied for the conditions present in the USSR. The low cost of natural gas in the USSR raises doubts as to the expediency of using nuclear reactors. An economic criterion is suggested for the effectiveness of the use of nuclear reactor heat in ferrous metallurgy (in comparison to natural gas). The question of the economic effectiveness of the use of nuclear reactors must be solved considering all its aspects on the scale of the entire economy of the nation. At the present time, the problem

has not yet gone beyond the stage of scientific research and experimental work. (JPRS)

4665 MATHEMATICAL OPTIMIZATION MODEL OF NUCLEAR POWER STRUCTURE BASED ON MINIMUM CONSUMPTION OF NUCLEAR FUEL. Bobolovich, V. N.; Koryakin, Yu. I. At. Energ. (USSR); 33: No. 6, 961-964(Dec 1972). (In Russian).

A mathematical optimization model of nuclear power structure based on the criterion of minimum consumption of nuclear fuel is described. The model has been used in forecasting studies of nuclear power development. Balance equations of capacity, electricity output, and plutonium serve as restrictions. The growth of nuclear power is considered on the basis of three and more types of reactors. (auth)

4666 NUCLEAR POWER IN JAPAN. Yoshioka, T. (Japan Atomic Power Co., Tokyo). J. Brit. Nucl. Energy Soc.; 12: No. 2, 135-138(Apr 1973).

The Japanese nuclear power generation program is outlined in a brief review of the types of reactors in use and under development. Problems relating to the industry, which are referred to, concern environmental safety and siting, disposal of radioactive waste, and supplies of enriched uranium. (UK)

Reactor Fuel Cycle Economics

Refer also to abstract 4665.

4667 (JUL-904-RG) KPD: PRESENT WORTH FUEL CYCLE CALCULATION METHODS AND CODES. Hansen, U. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 41p. Dep. NTIS (U. S. Sales Only) $4.25.

The methods used for fuel cycle evaluations are described. The calculations are based on present worth theory and all relevant equations are given to enable a detailed comparison with other codes in use. For each operational period all expenditures and revenues are calculated and discounted to the beginning of the period yielding the fuel cycle costs for that particular period. The method gives time dependent costs starting with the initial core and ending with the equilibrium phase. Each fuel charge handled in the in-pile and out-of-pile fuel management is treated separately. Cost calculations for a typical DRAGON power reactor design are included to show some of the features characterising running-in and equilibrium operating conditions. (auth)

4668 POSSIBILITY FOR DIVERSIFYING URANIUM DEMAND. Boxer, L. W. (Nuclear Energy Agency, Paris). J. Brit. Nucl. Energy Soc.; 12: No. 2, 153-157(Apr 1973).

Present assumptions on the growth of nuclear power in the OECD area indicate an increasingly heavy reliance on uranium capacity. Concern over the future security of oil supplies has prompted governments to examine contingencies more likely to yield early assurances on future energy supplies. The possibilities for nuclear power to make a major contribution in the medium rather than the long term are therefore under scrutiny. Provision of new enrichment capacity to supply Western Europe and Japan poses complex political and financial problems, delays in the solution of which may hamper the possibilities for accelerating the rate of growth of nuclear power. More recent experience with natural (or near natural) uranium fuel cycles in heavy water moderated reactors suggests that these alternatives could provide a substantial degree of self-sufficiency in the immediate future at acceptable costs. (auth)

Reactor Licensing and Regulation

4669 (DOCKET-50003-166) INDIAN POINT STATION, UNITS 1 AND 2. Findings of Security Measures. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 18 Apr 1973. 2p. (DOCKET-50247-100). Dep. NTIS $3.00.

4670 (DOCKET-50003-167) INDIAN POINT STATION, UNITS 1, 2, AND 3. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 5p. (DOCKET-50247-101; DOCKET-50286-79). Dep. NTIS $3.00.

4671 (DOCKET-50003-168) INDIAN POINT STATION, UNIT 1. Action Taken To Correct the Items of Noncompliance Brought to Attention Following Inspection on November 28-29, 1972. (Consolidated Edison Co. of New York, Inc., New York). 2 Mar 1973. 22p. Dep. NTIS $3.25.

Information is presented concerning the health physics program and radiation protection requirements. (DCC)

4672 (DOCKET-50003-169) INDIAN POINT STATION, UNIT 1. Endorsement to Nelia Policy No. NF-100. (Consolidated Edison Co. of New York, Inc., New York). 10 Apr 1973. 2p. Dep. NTIS $3.00.

4673 (DOCKET-50003-170) INDIAN POINT STATION, UNITS 1 AND 2. Certification That There Is No Applicable Effluent Limitation by New York State Department of Environmental Conservation. (New York State Dept. of Environmental Conservation, Albany, N. Y.). 24 Apr 1973. 4p. (DOCKET-50247-103). Dep. NTIS $3.00.

4674 (DOCKET-50003-171) INDIAN POINT STATION, UNIT 1. Action Taken to Correct Violations Brought to Attention Following Inspection on February 14-15, 1973. (Consolidated Edison Co. of New York, Inc., New York). 29 Mar 1973. 21p. Dep. NTIS $3.25.

Information is presented concerning the failure of the containment system isolation valves to close. (DCC)

4675 (DOCKET-50003-172) INDIAN POINT STATION, UNIT 1. Indemnity Agreement No. B-19, MAELU Policy No. MF-29, Endorsement No. 56; NELIA Policy No. NF-100, Endorsement No. 67. (Consolidated Edison Co. of New York, Inc., New York). 25 Apr 1973. 4p. Dep. NTIS $3.00.

4676 (DOCKET-50010-151) DRESDEN NUCLEAR POWER STATION, UNIT 1. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection of February 7, 8, 9, and 16, 1973. (Commonwealth Edison Co., Chicago, Ill.). 4 Apr 1973. 13p. Dep. NTIS $3.00.

Information on the chimney discharge rate for radioactive particulates at the Dresden Nuclear Power Station, Unit 1, is presented. (JWR)

4677 (DOCKET-50010-152) DRESDEN NUCLEAR POWER STATION, UNIT 1. Effectiveness of Emergency Condenser in Terminating a Transient Was Reduced. (Commonwealth Edison Co., Chicago, Ill.). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4678 (DOCKET-50010-153) DRESDEN NUCLEAR POWER STATION, UNIT 1. Endorsements Nos. 71 and 72 for MAELU Policy No. MF-22. (Commonwealth Edison Co., Chicago, Ill.). 24 Apr 1973. 3p. Dep. NTIS $3.00.

4679 (DOCKET-50010-154) DRESDEN NUCLEAR POWER STATION, UNIT 1. Fuel Densification, Nonproprietary Report, GU-5296. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). 18 Apr 1973. 35p. Dep. NTIS $3.75.

4680 (DOCKET-50016-191) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Endorsements Nos. 67, 68, 69, 70, and 71 to NELIA Policy No. NF-92. (Power Reactor Development Co., Detroit, Mich.). 16 Apr 1973. 8p. Dep. NTIS $3.00.

4681 (DOCKET-50016-192) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Change 37. (Directorate of Licensing (AEC), Washington, D. C.). 25 Apr 1973. 2p. Dep. NTIS $3.00.

A tec' nical specifications change which allows the sodium level in the reactor vessel to be lowered to facilitate retirement of parts of the primary system of the Enrico Fermi Atomic Power Plant, Unit 1, is described. (JWR)

4682 (DOCKET-50016-193) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Request for Authorization of a Change. (Power Reactor Development Co., Detroit, Mich.). 4 May 1973. 9p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning containment maintenance and testing requirements. (DCC)

4683 (DOCKET-50018-24) VALLECITOS BOILING WATER REACTOR. Annual Report No. 8, 1972. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). 11 Apr 1973. 4p. Dep. NTIS $3.00.

4684 (DOCKET-50029-239) YANKEE NUCLEAR POWER STATION. Overlay Applied to Exterior Surfaces of Valves. (Yankee Atomic Electric Co., Westboro, Mass). 19 Mar 1973. 2p. Dep. NTIS $3.00.

4685 (DOCKET-50029-240) YANKEE NUCLEAR POWER STATION. Incore Thermocouple Difficulty. (Yankee Atomic Electric Co., Westboro, Mass.). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4686 (DOCKET-50029-241) YANKEE NUCLEAR POWER STATION. Inspection Report No. 50-29/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 16 Mar 1973. 5p. Dep. NTIS $3.00.

4687 (DOCKET-50029-242) YANKEE NUCLEAR POWER STATION. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of

Regulatory Operations (AEC), Newark, N. J. Region I. 23 Feb 1973. 5p. Dep. NTIS $3.00.

4688 (DOCKET-50029-244) YANKEE NUCLEAR POWER STATION. Request Additional Information on Fuel Densification. (Directorate of Licensing (AEC), Washington, D. C.). 27 Apr 1973. 1p. Dep. NTIS $3.00.

4689 (DOCKET-50029-243) YANKEE NUCLEAR POWER STATION. Control Rod Surveillance Testing. (Yankee Atomic Electric Co., Westboro, Mass.). 24 Apr 1973. 3p. Dep. NTIS $3.00.

4690 (DOCKET-50029-245) YANKEE NUCLEAR POWER STATION. Schedule for Preparation and Submittal of new Final Safety Analysis Report. (Yankee Atomic Electric Co., Westboro, Mass.). 24 Apr 1973. 1p. Dep. NTIS $3.00.

4691 (DOCKET-50133-118) HUMBOLDT BAY POWER PLANT, UNIT 3. Efficiency of Full Facepiece Respirators. (Directorate of Licensing (AEC), Washington, D. C.). 25 Apr 1973. 2p. Dep. NTIS $3.00.

4692 (DOCKET-50155-149) BIG ROCK POINT NUCLEAR PLANT. Reinstalled 4 Assemblies. (Consumers Power Co., Jackson, Mich.). 10 Apr 1973. 1p. Dep. NTIS $3.00.

4693 (DOCKET-50155-150) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Change 36. (Directorate of Licensing (AEC), Washington, D. C.). 11 Apr 1973. 4p. Dep. NTIS $3.00.

Information is presented on a technical specifications change to clarify the requirements for operability of the emergency condenser tube bundles at the Big Rock Point Nuclear Plant. (JWR)

4694 (DOCKET-50155-151) BIG ROCK POINT NUCLEAR PLANT. Technical Specifications, Change 37. (Directorate of Licensing (AEC), Washington, D. C.). 25 Apr 1973. 18p. Dep. NTIS $3.00.

Information on technical specification changes concerning the plant reporting requirements and the radiation and respiratory protection program at the Big Rock Point Nuclear Plant is presented. (JWR)

4695 (DOCKET-50155-152) BIG ROCK POINT NUCLEAR PLANT. Missing Lower Rollers. (Consumers Power Co., Jackson, Mich.). 1 May 1973. 2p. Dep. NTIS $3.00.

Information is presented concerning missing lower rollers on control rod blades. (DCC)

4696 (DOCKET-50155-153) BIG ROCK POINT NUCLEAR PLANT. Radiation Survey. (Consumers Power Co., Jackson, Mich.). 2 May 1973. 1p. Dep. NTIS $3.00.

4697 (DOCKET-50155-154) BIG ROCK POINT NUCLEAR PLANT. Off-gas Holdup Time. (Consumers Power Co., Jackson, Mich.). 2 May 1973. 2p. Dep. NTIS $3.00.

4698 (DOCKET-50171-119) PEACH BOTTOM ATOMIC POWER STATION, UNITS 1, 2, AND 3. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 3p. (DOCKET-50277-88; DOCKET-50278-83). Dep. NTIS $3.00.

4699 (DOCKET-50171-120) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Investigation of the Slow Scram Time of the 3C Control Rod. (Philadelphia Electric Co., PA). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4700 (DOCKET-50171-121) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Order Extending Provisional Operating License Expiration Date to June 24, 1974. (Directorate of Licensing (AEC), Washington, D. C.). Apr 1973. 6p. Dep. NTIS $3.00.

4701 (DOCKET-50171-122) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Technical Specifications, Change 16, Efficiency of Full Facepiece Respirators. (Directorate of Licensing (AEC), Washington, D. C.). 25 Apr 1973. 2p. Dep. NTIS $3.00.

4702 (DOCKET-50206-196) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications, Change 8. (Directorate of Licensing (AEC), Washington, D. C.). Apr 1973. 4p. Dep. NTIS $3.00.

Information on a technical specifications change which extends the limit on average core burnup for Cycle 3 at the San Onofre Nuclear Generating Station, Unit 1, is presented. (JWR)

4703 (DOCKET-50206-197) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Schedule for Review of Application for Full-Term Operating License. (Directorate of Licensing (AEC), Washington, D. C.). 4 Apr 1973. 4p. Dep. NTIS $3.00.

4704 (DOCKET-50206-198) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Plans for Refueling. (Southern California Edison Co., Rosemead, Calif.). 26 Apr 1973. 5p. Dep. NTIS $3.00.

4705 (DOCKET-50206-199) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Summary Analysis of the April 30 Incident. (Westinghouse Electric Corp., Pittsburgh, PA). Apr 1973. 63p. (WCAP-8099). Dep. NTIS $5.25.

On April 30, 1972, the San Onofre Nuclear Generating Station sustained a unit trip with the subsequent actuation of safety injection equipment. Because the April 30 incident cannot be defined as a design transient, it was concluded that an analysis should be performed to determine the effect of the resulting thermal stresses on the primary system components. Emphasis was directed to the reactor vessel inlet nozzle, beltline region, safety injection system nozzle, and charging line nozzle. Because a postulated loss-of-coolant accident with accompanying safety injection represents the limiting case for thermal shock (greatest ΔT), the LOCA was also included in the analysis for the regions of interest. Because of the elevated temperature (444°F) and the low stress intensity factor K_I, fast fracture was not considered a matter of concern. The analysis shows that during the April 30 incident, the San Onofre Generating Station did not undergo any fatigue damage. It was also determined that if the San Onofre Generating Unit were to sustain a loss-of-coolant accident (LOCA), the integrity of the reactor vessel beltline, reactor vessel inlet nozzle, safety injection nozzle, and charging line nozzle would be maintained. (auth)

4706 (DOCKET-50213-187) HADDAM NECK PLANT, UNIT 1. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. Dep. NTIS $4.75.

4707 (DOCKET-50213-188) HADDAM NECK PLANT, UNIT 1. Action Taken to Correct Violation Brought to Attention Following Inspection, February 5-9, 1973. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 20 Mar 1973. 20p. Dep. NTIS $3.00.

Information on the monthly tests of the containment air filtration system at the Haddam Neck Plant, Unit 1, is presented. (JWR)

4708 (DOCKET-50213-189) HADDAM NECK PLANT, UNIT 1. Fuel Densification Effects. (Connecticut Yankee Atomic Power Co., Hartford). 27 Apr 1973. 20p. Dep. NTIS $3.00.

4709 (DOCKET-50213-190) HADDAM NECK PLANT, UNIT 1. Operation Report No. 73-3 for Month of March 1973. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 25 Apr 1973. 14p. (NYO-3144-82). Dep. NTIS $3.00.

4710 (DOCKET-50213-191) HADDAM NECK PLANT, UNIT 1. Technical Specifications, Proposed Change 23. (Connecticut Yankee Atomic Power Co., Hartford). Apr 1973. 12p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning heatup and cooldown limits for the pressure vessel and primary cooling system. (DCC)

4711 (DOCKET-50219-250) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 4p. Dep. NTIS $3.00.

4712 (DOCKET-50219-251) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Isolation Condenser Valve Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4713 (DOCKET-50219-252) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Electromatic Relief Valve Failure. (Jersey Central Power and Light Co., Morristown, N. J.). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4714 (DOCKET-50219-253) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Technical Specifications, Change 13. (Directorate of Licensing (AEC), Washington, D. C.). 24 Apr 1973. 3p. Dep. NTIS $3.00.

Information on a technical specifications change which specifies

a new load setting for the refueling interlocks grapple switch at the Oyster Creek Nuclear Power Plant Unit 1, is presented. (JWR)

4715 (DOCKET-50219-254) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Action to be Taken to Correct Items of Violation Brought to Attention Following Inspection on March 13, 1973. (Jersey Central Power and Light Co., Morristown, N. J.). 28 Mar 1973. 27p. Dep. NTIS $3.50.
Requested information is presented concerning radiation protection requirements for operation. (DCC)

4716 (DOCKET-50219-255) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Action Taken to Correct Violations Brought to Attention Following Inspection on November 9, 10, 12, 13, 17, 20 and December 7 and 8, 1972. (Jersey Central Power and Light Co., Morristown, N. J.). 27 Mar 1973. 44p. Dep. NTIS $4.25.
Information is presented concerning radiation protection and radioactive waste storage requirements. (DCC)

4717 (DOCKET-50219-256) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Inquiry Report No. 50-219/73-06Q, Drain Valve Open on Chromated Water Tank Truck. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 30 Apr 1973. 2p. Dep. NTIS $3.00.

4718 (DOCKET-50219-257) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Application for a Full Term License, Supplement 5. (Jersey Central Power and Light Co., Morristown, N. J.). 2 May 1973. 7p. Dep. NTIS $3.00.
Additional information is presented concerning the fuel shipping cask drop protection system. (DCC)

4719 (DOCKET-50220-135) NINE MILE POINT NUCLEAR STATION, UNIT 1. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 4p. Dep. NTIS $3.00.

4720 (DOCKET-50220-136) NINE MILE POINT NUCLEAR STATION, UNIT 1. Technical Specifications, Change 7. (Directorate of Licensing (AEC), Washington, D. C.). 18 Apr 1973. 4p. Dep. NTIS $3.00.
Information is presented on a temporary change in technical specifications for the Nine Mile Point Nuclear Station, Unit 1 to permit draining of the torus for maintenance purposes while control rod drive removal and Local Power Range Monitor replacement are being performed. (JWR)

4721 (DOCKET-50237-321) DRESDEN NUCLEAR POWER STATION, UNIT 2. Special Report No. 22, Startup Test Report, Supplement A. (Commonwealth Edison Co., Chicago, Ill.). 17 Apr 1973. 2p. Dep. NTIS $3.00.

4722 (DOCKET-50237-322) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Special Report No. 23, Drywell to Torus Vacuum Breakers. (Commonwealth Edison Co., Chicago, Ill.). Apr 1973. 30p. (DOCKET-50249-216). Dep. NTIS $3.50.

4723 (DOCKET-50237-323) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Secondary Containment Integrity Not in Effect. (Commonwealth Edison Co., Chicago, Ill.). 27 Apr 1973. 2p. (DOCKET-50249-217). Dep. NTIS $3.00.

4724 (DOCKET-50237-324) DRESDEN NUCLEAR POWER STATION, UNIT 2. Special Report No. 24, Response of Dresden Unit 2 to Transient Tests without the Flow Biased Scram Circuit. (Commonwealth Edison Co., Chicago, Ill.). 27 Apr 1973. 5p. Dep. NTIS $3.00.

4725 (DOCKET-50244-153) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 5p. Dep. NTIS $3.00.

4726 (DOCKET-50244-154) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Analysis of Capsule V from the Reactor Vessel Surveillance Program. (Rochester Gas and Electric Corp., N. Y.). 1 Apr 1973. 59p. Dep. NTIS $5.00.

4727 (DOCKET-50245-213) MILLSTONE NUCLEAR POWER STATION, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 4p. (DOCKET-50336-53). Dep. NTIS $3.00.

4728 (DOCKET-50245-214) MILLSTONE NUCLEAR POWER STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of the Federal Power Commission. (Federal Power Commission, Washington, D. C. Bureau of Power). 25 Apr 1973. 8p. (DOCKET-50336-54). Dep. NTIS $3.00.

4729 (DOCKET-50245-215) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-245/73-04. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 27 Mar 1973. 17p. Dep. NTIS $3.00.

4730 (DOCKET-50245-216) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-245/73-07. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 29 Mar 1973. 7p. Dep. NTIS $3.00.

4731 (DOCKET-50245-217) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Action Taken to Correct Violation Brought to Attention Following Inspection on January 8-10, 1973. (Millstone Point Co., Hartford, Conn.). 15 Mar 1973. 20p. Dep. NTIS $3.00.
Information is presented concerning the control rod drive system accumulator plating failures. (DCC)

4732 (DOCKET-50245-218) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Investigation of a Piping Support Failure on the LPCI Crossover Line. (Teledyne Materials Research Co., Waltham, Mass.). 23 Jan 1973. 100p. Dep. NTIS $7.00.
For Millstone Point Co., Hartford, CT.

4733 (DOCKET-50245-219) MILLSTONE NUCLEAR POWER STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Wahsington, D. C. (USA)). 23 Apr 1973. 6p. (DOCKET-50336-56). Dep. NTIS $3.00.

4734 (DOCKET-50247-102) INDIAN POINT NUCLEAR GENERATING UNIT 2. Inspection Report No. 50-247/73-05, Valve Wall Thickness. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Mar 1973. 11p. Dep. NTIS $3.00.

4735 (DOCKET-50247-104) INDIAN POINT NUCLEAR GENERATING UNIT 2. Inspection Report No. 50-247/73-04. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 29 Mar 1973. 18p. Dep. NTIS $3.00.

4736 (DOCKET-50247-105) INDIAN POINT NUCLEAR GENERATING UNIT 2. Both Doors of 80' ELEVATION PERSONNEL AIR LOCK WERE INADVERTENTLY PLACED IN THE OPEN POSITION. (Consolidated Edison Co. of New York, Inc., New York). 27 Apr 1973. 2p. Dep. NTIS $3.00.

4737 (DOCKET-50247-106) INDIAN POINT NUCLEAR GENERATING UNIT 2. Facility Operating License No. DPR-26, Amendment 2. (Directorate of Licensing (AEC), Washington, D. C.). 27 Apr 1973. 9p. Dep. NTIS $3.00.
The amendment to the operating license permits the operation of the reactor for testing purposes at 1379 MW(t). (DCC)

4738 (DOCKET-50247-107) INDIAN POINT NUCLEAR GENERATING UNIT 2. Number 22 Main Steam Isolation Valve Failed to Close. (Consolidated Edison Co. of New York, Inc., New York). 4 May 1973. 3p. Dep. NTIS $3.00.

4739 (DOCKET-50249-207) DRESDEN NUCLEAR POWER STATION, UNIT 3. No Applicable Effluent Limitation, Illinois Environmental Protection Agency. (Illinois Environmental Protection Agency, Springfield (USA)). 30 Mar 1973. 2p. Dep. NTIS $3.00.

4740 (DOCKET-50249-214) DRESDEN NUCLEAR POWER STATION, UNIT 3. Approximately 28 Reload 1 Fuel Bundles Will Replace an Equal Number of Initial Fuel Bundles. (Directorate of Licensing (AEC), Washington, D. C.). 11 Apr 1973. 4p. Dep. NTIS $3.00.

4741 (DOCKET-50249-215) DRESDEN NUCLEAR POWER STATION, UNIT 3. Two of Four Sustained High Reactor Pressure Switches out of Calibration. (Commonwealth Edison Co., Chicago, Ill.). 19 Apr 1973. 4p. Dep. NTIS $3.00.

4742 (DOCKET-50250-122) TURKEY POINT PLANT, UNITS 3 AND 4. Confirmation that Construction and Operation of Plant will not Violate Applicable Water Quality Standards, State of Florida Department of Pollution Control. (Florida Dept. of Pollution Control, Tallahassee (USA)). 5 Apr 1973. 2p. (DOCKET-50251-102). Dep. NTIS $3.00.

4743 (DOCKET-50254-183) QUAD-CITIES STATION, UNITS 1 AND 2. No Applicable Effluent Limitation, Illinois Environmental Protection Agency, Springfield (USA)). 30 Mar 1973. 2p. (DOCKET-50265-173). Dep. NTIS $3.00.

4744 (DOCKET-50254-189) QUAD CITIES STATION, UNIT 1. Coolant Conductivity Limit Exceeded April 6, 1973. (Commonwealth Edison Co., Cordova, Ill.). 18 Apr 1973. 2p. Dep. NTIS $3.00.

4745 (DOCKET-50254-190) QUAD-CITIES STATION, Unit 1. Three Switches out of Calibration. (Commonwealth Edison Co., Cordova, Ill.). 30 Apr 1973. 2p. Dep. NTIS $3.00.
Information is presented concerning the incorrect calibration of 3 switches for the low level scram sensors. (DCC)

4746 (DOCKET-50254-191) QUAD-CITIES STATION, UNITS 1 AND 2. Startup Test Results. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Mar 1973. 175p. (DOCKET-50265-180; NEDC-10810). Dep. NTIS $10.75.

4747 (DOCKET-50254-192) QUAD-CITIES STATION, UNITS 1 AND 2. Special Report No. 3B, Supplementary Information Concerning Condensate Pump Room Modifications. (Commonwealth Edison Co., Chicago, Ill.). 27 Apr 1973. 7p. (DOCKET-50265-181). Dep. NTIS $3.00.

4748 (DOCKET-50254-196) QUAD-CITIES STATION, UNITS 1 AND 2. Inspection Reports No. 050-254/71-13, No. 050-265/71-13, and No. 050-254/71-14. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 26 Apr 1973. 33p. (DOCKET-50265-185). Dep. NTIS $3.75.

4749 (DOCKET-50254-197) QUAD-CITIES STATION, UNITS 1 AND 2. Inspection Reports No. 050-254/73-02 and No. 050-265/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 30 Apr 1973. 9p. (DOCKET-50265-186). Dep. NTIS $3.00.

4750 (DOCKET-50254-198) QUAD-CITIES STATION, UNITS 1 AND 2. Relief Valve Blowdown Test Program. (General Electric Co., San Jose, Calif. Nuclear Energy Div). 30 Apr 1973. 2p. (DOCKET-50265-187). Dep. NTIS $3.00.

4751 (DOCKET-50254-199) QUAD-CITIES STATION, UNITS 1 AND 2. Setpoint Drifts in Water Level Instruments. (Commonwealth Edison Co., Cordova, Ill). 3 May 1973. 2p. (DOCKET-50265-188). Dep. NTIS $3.00.

4752 (DOCKET-50255-152) PALISADES PLANT. Request for Personnel Exposure Records on Semiannual Basis. (Directorate of Licensing (AEC), Washington, D. C.). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4753 (DOCKET-50255-153) PALISADES PLANT. Technical Specifications, Request for Modification. (Consumers Power Co., Jackson, Mich.). 26 Apr 1973. 3p. Dep. NTIS $3.00.
Information is presented concerning revised operating limits for the reactor. A plot of the average fuel temperature versus linear heat rate for an 1800°F peak LOCA clad temperature is included. (DCC)

4754 (DOCKET-50255-157) PALISADES PLANT. Effluents Reports, March and April 1973. (Consumers Power Co., Jackson, Mich.). 11 May 1973. 3p. Dep. NTIS $3.00.

4755 (DOCKET-50259-88) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Final Deficiency Report on Control Rod Drive and Standby Gas Treatment Systems. (Tennessee Valley Authority, Chattanooga). 23 Apr 1973. 3p. (DOCKET-50260-82; DOCKET-50296-78). Dep. NTIS $3.00.

4756 (DOCKET-50259-90) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Corrective Action Taken After Inspection of December 14 and 20-21, 1972. (Tennessee Valley Authority, Chattanooga). 2 May 1973. 29p. Dep. NTIS $3.50.
Information is presented concerning water hammer problems in the high pressure coolant injection and reactor core isolation cooling turbine exhaust lines in the torus. (DCC)

4757 (DOCKET-50259-91) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Inspection Report No. 50-259/73-4. (Directorate of Regulatory Operations (AEC), Atlanta, GA (USA). Region II). 8 May 1973. 25p. Dep. NTIS $3.25.

4758 (DOCKET-50259-92) BROWNS FERRY NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Inquiry Report Nos. 50-259/73-1Q/CDR, 50-260/73-1Q/CDR, 50-296/73-1Q/CDR, Lack of Seismic Qualifications, Control Rod Drive (CRD) and Standby Gas Treatment (SGT) Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 9 May 1973. 5p. (DOCKET-50260-84; DOCKET-50296-80). Dep. NTIS $3.00.

4759 (DOCKET-50280-130) SURRY POWER STATION, UNITS 1 AND 2. Technical Specifications, Change 7. (Directorate of Licensing (AEC), Washington, D. C.). May 1972. 2p. (DOCKET-50281-104). Dep. NTIS $3.00.
Information on a technical specifications change concerning full facepiece respirators in use at the Surry Power Station, Units 1 and 2, is presented. (JWR)

4760 (DOCKET-50261-160) H. B. ROBINSON UNIT 2. No Applicable Effluent Limit, South Carolina Pollution Control Authority. (South Carolina Pollution Control Authority, Columbia (USA)). 30 Mar 1972. 2p. Dep. NTIS $3.00.

4761 (DOCKET-50261-164) H. B. ROBINSON UNIT 2. Technical Specifications, Change 16. (Directorate of Licensing (AEC), Washington, D. C.). 4 Apr 1973. 4p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning the methyl iodide removal efficiency of charcoal filters during testing for the spent fuel building and containment purge exhaust system. (DCC)

4762 (DOCKET-50261-171) H. B. ROBINSON UNIT 2. Routine Operating Report No. 5 for Period October 1-December 31, 1972. (Caroline Power and Light Co., Raleigh, N. C.). 24 Apr 1973. Dep. NTIS $5.25.

4763 (DOCKET-50261-172) H. B. ROBINSON UNIT 2. Refueling Water Storage Tank Spill to the Plant Drainage System. (Carolina Power and Light Co., Raleigh, N. C.). 1 May 1973. 4p. Dep. NTIS $3.00.

4764 (DOCKET-50263-201) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specifications, Change No. 6. (Directorate of Licensing (AEC), Washington, D. C.). 3 Apr 1973. 32p. Dep. NTIS $3.75.
Revised technical specifications are presented concerning administrative controls for reactor operations. (DCC)

4765 (DOCKET-50263-202) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050-263/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 13 Apr 1973. 9p. Dep. NTIS $3.00.

4766 (DOCKET-50263-203) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. No. 12 Diesel Generator Breaker Closed Automatically to No. 16 Emergency Bus. (Northern States Power Co., Minneapolis, Minn.). 24 Apr 1973. 1p. Dep. NTIS $3.00.

4767 (DOCKET-50263-204) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of LPCI Injection Valve to Open. (Northern States Power Co., Minneapolis, Minn.). 24 Apr 1973. 1p. Dep. NTIS $3.00.

4768 (DOCKET-50263-205) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. RHR Service Water Pump Seal Problem. (Northern States Power Co., Minneapolis, Minn.). 19 Apr 1973. 2p. Dep. NTIS $3.00.

4769 (DOCKET-50263-206) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050-263/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 16 Apr 1973. 18p. Dep. NTIS $3.00.

4770 (DOCKET-50267-61) FORT ST. VRAIN NUCLEAR GENERATING STATION. Annual Environmental Radiation Surveillance Program Report and Summary of 1969-1972 Preoperational Measurements. (Colorado State Univ., Fort Collins). Mar 1973. 122p. Dep. NTIS $8.25.
For Public Service Co. of Colorado, Denver.

4771 (DOCKET-50267-62) FORT ST. VRAIN NUCLEAR GENERATING STATION. Valve Wall Thickness. (Public Service Co. of Colorado, Denver). 26 Apr 1973. 4p. Dep. NTIS $3.00.

4772 (DOCKET-50269-100) OCONEE NUCLEAR STATION, UNIT 1. Operational Quality Assurance Program. (Duke Power Co., Charlotte, N. C.). 27 Apr 1973. 11p. Dep. NTIS $3.00.

4773 (DOCKET-50269-101) OCONEE NUCLEAR STATION, UNIT 1. Technical Specifications, Change No. 1. (Directorate of Licensing (AEC), Washington, D. C.). 30 Apr 1973. 3p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning restrictions on maximum power. (DCC)

4774 (DOCKET-50269-103) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Simultaneous Actuation of the Safety Injection Signal on Both Units of a Dual Unit Facility, Supplementary Information. (Duke Power Co., Charlotte, N. C.). 2 May 1973. 2p. (DOCKET-50270-85; DOCKET-50287-77). Dep. NTIS $3.00.

4775 (DOCKET-50269-104) OCONEE NUCLEAR STATION, UNIT 1. Technical Specifications, Change No. 2. (Directorate of Licensing (AEC), Washington, D. C.). 4 May 1973. 3p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning protection factors for personnel respiratory protective equipment. (DCC)

4776 (DOCKET-50269-105) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Endorsement No. 24 to NELIA Policy No. NF-182 AND MAELU Policy No. MF-61 with Endorsements 1 through 11. (Duke Power Co., Charlotte, N. C.). 20 Apr 1973. 20p. (DOCKET-50270-87; DOCKET-50287-87). Dep. NTIS $3.00.

4777 (DOCKET-50269-106) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Final Safety Analysis Report, Revision 28. (Duke Power Co., Charlotte, N. C.). 1 May 1973. 71p. (DOCKET-50270-88; DOCKET-50287-79). Dep. NTIS $5.75.
Revised and additional data are presented concerning the environmental monitoring program, personnel, and technical specifications. (DCC)

4778 (DOCKET-50269-107) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Review of Control Circuits and Safety Related Equipment. (Duke Power Co., Charlotte, N. C.). 3 May 1973. 1p. (DOCKET-50270-89; DOCKET-50287-80). Dep. NTIS $3.00.

4779 (DOCKET-50271-174) VERMONT YANKEE NUCLEAR POWER STATION. AO-73-10, Relief Valve Initiation Time Delay Relay out of Calibration. (Vermont Yankee Nuclear Power Corp., Rutland). 20 Apr 1973. 2p. Dep. NTIS $3.00.

4780 (DOCKET-50271-176) VERMONT YANKEE NUCLEAR POWER STATION. Technical Specifications, Change No. 7. (Directorate of Licensing (AEC), Washington, D. C.). 30 Apr 1973. 3p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning protection factors for personnel respiratory protective equipment. (DCC)

4781 (DOCKET-50271-177) VERMONT YANKEE NUCLEAR POWER STATION. Faulty Overcurrent Trip Delay Devices in Circuit Breakers for Engineered Safety Systems. (Vermont Yankee Nuclear Power Corp., Rutland). 21 Mar 1973. 4p. Dep. NTIS $3.00.

4782 (DOCKET-50271-178) VERMONT YANKEE NUCLEAR POWER STATION. Inspection Report No. 50-271/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 21 Mar 1973. 15p. Dep. NTIS $3.00.

4783 (DOCKET-50271-179) VERMONT YANKEE NUCLEAR POWER STATION. AO-73-11, the SBGT "B" Train Did Not Start on Signal. (Vermont Yankee Nuclear Power Corp., Rutland). 26 Apr 1973. 1p. Dep. NTIS $3.00.

4784 (DOCKET-50271-180) VERMONT YANKEE NUCLEAR POWER STATION. AO-73-12, Valve Failed to Open on May 7, 1973. (Vermont Yankee Nuclear Power Corp., Rutland). 8 May 1973. 1p. Dep. NTIS $3.00.
Information is presented concerning the failure of a valve to open fully for the low pressure coolant injection system. (DCC)

4785 (DOCKET-50272-56) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of Wilmington Metropolitan Area Planning Coordinating Council. (Wilmington Metropolitan Area Planning Coordinating Council, New Castle, Del. (USA)). 29 Mar 1973. 5p. (DOCKET-50311-56). Dep. NTIS $3.00.

4786 (DOCKET-50272-61) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Public Service Electric and Gas Co., Newark, N. J.). 3 Apr 1973. 4p. (DOCKET-50311-61). Dep. NTIS $3.00.

4787 (DOCKET-50272-62) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Action Taken to Correct Items of Violations Brought to Attention Following Inspection on December 12, 13, 14, and 20, 1972. (Public Service Electric and Gas Co. Newark, N. J.). 5 Mar 1973. 63p. (DOCKET-50311-62) Dep. NTIS $5.25.
Information is presented concerning quality assurance and quality control requirements during construction. (DCC)

4788 DOCKET-50272-63) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Water Quality Certification. (Public Service Electric and Gas Co., Newark, N. J). 17 Apr 1973. 5p. (DOCKET-50311-63). Dep. NTIS $3.00.

4789 (DOCKET-50272-64) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Review of Control Circuits for Safety Related Equipment. (Public Service Electric and Gas Co., Newark, N. J.). 23 Apr 1973. 1p. (DOCKET-50311-64). Dep. NTIS $3.00.

4790 (DOCKET-50272-65) SALEM NUCLEAR GENERATING STATION, UNIT 1. Inspection Report No. 50-272/73-03. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 9 Apr 1973. 22p. Dep. NTIS $3.25.

4791 (DOCKET-50275-36) DIABLO CANYON NUCLEAR POWER PLANT, UNITS 1 AND 2. Draft Environmental Statement, Comments of Resources Agency of California. (Resources Agency of California, Sacramento (USA)). 3 Apr 1973. 9p. (DOCKET-50323-33). Dep. NTIS $3.00.

4792 (DOCKET-50277-87) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Final Safety Analysis Report, Amendment No. 26. (Philadelphia Electric Co., PA). 30 Apr 1973. 459p. (DOCKET-50278-82). Dep. NTIS $25.00
Revised information on the Peach Bottom Atomic Power Station, Units 2 and 3 is presented under the following headings: quality assurance program; site; reactor physics; cooling system; containment system; engineered safeguards; electrical system; instrumentation; control system; auxiliary systems; power conversion system; test program; and safety analysis. (JWR)

4793 (DOCKET-50277-89) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Inspection Report No. 50-277/73-05. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 29 Mar 1973. 28p. Dep. NTIS $3.50.

4794 (DOCKET-50277-90) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Action Taken to Correct Items of Violation Brought to Attention Following Inspection January 30, 31 and February 1, 1973. (Philadelphia Electric Co., PA). 12 Apr 1973. 25p. Dep. NTIS $3.25.
Information is presented concerning the installation of electrical cables and the identification procedures for flood damaged equipment. (DCC)

4795 (DOCKET-50278-84) PEACH BOTTOM ATOMIC POWER STATION, UNIT 3. Action taken to Correct Items of Violation Brought to Attention Following Inspections of January 30, 31 and February 1, 1973. (Philadelphia Electric Co., PA). 12 Apr 1973. 24p. Dep. NTIS $3.25.
Information is presented concerning the installation of electrical cables and the identification procedures for flood damaged equipment. (DCC)

4796 (DOCKET-50280-119) SURRY POWER STATION, UNITS 1 AND 2. Inquiry from Reclaim the James. (Reclaim the James, Richmond, Va. (USA)). 2 Apr 1973. 2p. (DOCKET-50281-96). Dep. NTIS $3.00.
Information is requested concerning the environmental impact of the Surry Power Reactor Units 1 and 2 on the James River. (DCC)

4797 (DOCKET-50280-126) SURRY POWER STATION, UNIT 1. AO-S1-73-05, Failure of Main Steam Line Valve to Close. (Virginia Electric and Power Co., Richmond). 16 Apr 1973. 11p. Dep. NTIS $3.00.

4798 (DOCKET-50280-127) SURRY POWER STATION, UNIT 1. AO-S1-73-06, Failure of Boron Injection Tank Outlet Valve. (Virginia Electric and Power Co., Richmond). 18 Apr 1973. 6p. Dep. NTIS $3.00.

4799 (DOCKET-50280-128) SURRY POWER STATION, UNIT 1. AO-S2-73-03, Failure of Air Starting System of Emergency Diesel No. 3. (Virginia Electric and Power Co., Richmond). 18 Apr 1973. 7p. Dep. NTIS $3.00.

4800 (DOCKET-50280-129) SURRY POWER STATION, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Virginia Electric and Power Co., Richmond). 1 May 1973. 5p. (DOCKET-50281-103). Dep. NTIS $3.00.

4801 (DOCKET-50282-101) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Draft Environmental Statement, Comments of Minnesota Pollution Control Agency. (Minnesota Pollution Control Agency, Minneapolis (USA)). 30 Mar 1973. 8p. (DOCKET-50306-96). Dep. NTIS $3.00.

4802 (DOCKET-50281-102) SURRY POWER STATION, UNIT 2. Inspection Report No. 50-281/73-4. (Directorate of

Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 7 May 1973. 14p. Dep. NTIS $3.00.

4803 (DOCKET-50282-107) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Inspection Report No. 050-282/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 11 Apr 1973. 17p. Dep. NTIS $3.00.

4804 (DOCKET-50282-108) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Inspection Reports No. 050-282/73-07 and No. 050-306/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 13 Apr 1973. 7p. (DOCKET-50306-101). Dep. NTIS $3.00.

4805 (DOCKET-50282-110) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Safety Evaluation, Supplement No. 2. (Directorate of Licensing (AEC), Washington, D. C.). 30 Apr 1973. 35p. (DOCKET 50306-103). Dep. NTIS $3.75.

4806 (DOCKET-50282-111) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 34. (Northern States Power Co., Minneapolis, Minn.). 1 May 1973. 225p. (DOCKET-50306-104). Dep. NTIS $13.25.

Safety analysis is presented for high energy pipe rupture outside the containment structure. (DCC)

4807 (DOCKET-50282-112) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Policy No. NF-197, Endorsement 13. (Northern States Power Co., Minneapolis, Minn.). 9 Apr 1973. 2p. (DOCKET-50306-105). Dep. NTIS $3.00.

4808 (DOCKET-50282-113) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Application for (a) Class 104b Operating Licenses for Utilization Facilities (b) Special Nuclear Material Licenses and (c) By-Product Material Licenses. (Northern States Power Co., Minneapolis, Minn.). 9 Apr 1973. 19p. (DOCKET-50306-106). Dep. NTIS $3.00.

Information is presented concerning the fuel densification effect on peak temperature during coolant loss accidents and sensitivity of peak clad temperature following coolant loss accident to containment pressure. (DCC)

4809 (DOCKET-50282-114) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Draft Environmental Statement, Comments of United States Environmental Protection Agency. 4 May 1973. 22p. (DOCKET-50306-107). Dep. NTIS $3.25.

4810 (DOCKET-50285-91) FORT CALHOUN STATION, UNIT 1. Justification for 1420 Mwt Operation of the Fort Calhoun Reactor under Fuel Densification Conditions (CENPD-99). (Omaha Public Power District, Neb.). 6 Apr 1973. 91p. Dep. NTIS $6.75.

4811 (DOCKET-50285-92) FORT CALHOUN STATION, UNIT 1. Safety Evaluation and Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 23 Apr 1973. 159p. Dep. NTIS $10.00.

4812 (DOCKET-50285-93) FORT CALHOUN STATION, UNIT 1. Inspection Report No. 50-285/73-05. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 5 Apr 1973. 15p. Dep. NTIS $3.00.

4813 (DOCKET-50286-77) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement No. 17. (Consolidated Edison Co. of New York, Inc., New York). 27 Apr 1973. 117p. Dep. NTIS $8.00.

Revised and additional data are presented concerning the emergency plan and engineered safeguards. (DCC)

4814 (DOCKET-50286-78) INDIAN POINT NUCLEAR GENERATING UNIT 3. Applicant's Environmental Report, Supplement 8. (Consolidated Edison Co. of New York, Inc., New York). 30 Apr 1973. 172p. Dep. NTIS $10.75.

4815 (DOCKET-50286-80) INDIAN POINT NUCLEAR GENERATING UNIT 3. Inspection Report No. 50-286/73-03. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I) 11 Apr 1973. 14p. Dep. NTIS $3.00.

4816 (DOCKET-50289-95) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers and Engineered Safety Systems. (Metropolitan Edison Co., Reading, PA). 10 Apr 1973. 5p. (DOCKET-50320-45). Dep. NTIS $3.00.

4817 (DOCKET-50289-96) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment 39. (Metropolitan Edison Co., Reading, Pa.). 27 Apr 1973. 73p. Dep. NTIS $5.75.

Safety analyses of loss-of-coolant accidents resulting from core flooding line breaks in the Three Mile Island Nuclear Station, Unit 1, are presented. (JWR)

4818 (DOCKET-50293-132) PILGRIM NUCLEAR POWER STATION. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Boston Edison Co., Mass.). 8 Mar 1973. 1p. Dep. NTIS $3.00.

4819 (DOCKET-50293-133) PILGRIM NUCLEAR POWER STATION. Inquiry Report No. 50-293/73-01Q. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 17 Apr 1973. 1p. Dep. NTIS $3.00.

Information is presented concerning the in-core movement of a fuel bundle by a control rod. (DCC)

4820 (DOCKET-50293-135) PILGRIM NUCLEAR POWER STATION. UO-73-5, Service Water Pump Failure. AO 73-14, Two Switches out of Calibration. (Boston Edison Co., Mass.). 26 Apr 1973. 3p. Dep. NTIS $3.00.

4821 (DOCKET-50293-136) PILGRIM NUCLEAR POWER STATION. Inspection Report No. 50-293/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 1 May 1973. 12p. Dep. NTIS $3.00.

4822 (DOCKET-50293-137) PILGRIM NUCLEAR POWER STATION. Resin Break Through in Coolant Water, May 7, 1973. (Boston Edison Co., Mass.). 8 May 1973. 2p. Dep. NTIS $3.00.

4823 (DOCKET-50295-100) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-13. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 10 Apr 1973. 9p. Dep. NTIS $3.00.

4824 (DOCKET-50295-101) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-14. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 12 Apr 1973. 10p. Dep. NTIS $3.00.

4825 (DOCKET-50295-102) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Operating Error in Testing of Source Range Detectors. (Commonwealth Edison Co., Chicago, Ill.). 24 Apr 1973. 2p. Dep. NTIS $3.00.

4826 (DOCKET-50295-104) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 050-295/73-09. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 30 Apr 1973. 3p. Dep. NTIS $3.00.

4827 (DOCKET-50295-105) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Indemnity Agreement No. B-59, Amendment 3. (Commonwealth Edison Co., Chicago, Ill.). 11 Apr 1973. 3p. (DOCKET-50304-91). Dep. NTIS $3.00.

4828 (DOCKET-50295-106) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Review of Control Circuits for Safety Related Equipment. (Commonwealth Edison Co., Chicago, Ill.). 30 Apr 1973. 1p. (DOCKET-50304-92). Dep. NTIS $3.00.

4829 (DOCKET-50295-107) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Fuel Densification Report, Addendum. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 1p. Dep. NTIS $3.00.

4830 (DOCKET-50295-108) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 28. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 156p. (DOCKET-50304-93). Dep. NTIS $10.00.

Revised and requested information is presented concerning accident analysis, fuel densification, pipe breaks outside the containment, and containment structure pressure analysis. (DCC)

4831 (DOCKET-50295-109) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Steps taken to Correct Items of Noncompliance Brought to Attention Following Inspection of January 24 and 26 and February 5, 6, 13, 14 and 23, 1973. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 22p. Dep. NTIS $3.25.

Requested information is presented concerning quality assurance procedures and preoperational test requirements. (DCC)

4832 (DOCKET-50298-76) COOPER NUCLEAR STATION. Failure of Circuit Breakers in Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Denver, Colo. Region IV). 20 Feb 1973. 7p. Dep. NTIS $3.00

4833 (DOCKET-50298-77) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 21. (Nebraska Public Power District, Columbus). 23 Apr 1973. 29p. Dep. NTIS $3.50.
Revised and requested information on the site for the Cooper Nuclear Station is presented. (JWR)

4834 (DOCKET-50301-93) POINT BEACH NUCLEAR POWER PLANT, UNIT 2. Proposal to Delete Further Load Rejection Testing. (Wisconsin Electric Power Co., Milwaukee). 23 Apr 1973. 3p. Dep. NTIS $3.00.

4835 (DOCKET-50301-94) POINT BEACH NUCLEAR POWER PLANT, UNIT 2. Sudden Closure of Main Steam Stop Valves. (Wisconsin Electric Power Co., Milwaukee). 2 May 1973. 4p. Dep. NTIS $3.00.

4836 (DOCKET-50302-69) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Inadvertent Disabling of Components. (Florida Power Corp., St. Petersburg). 19 Apr 1973. 1p. Dep. NTIS $3.00.

4837 (DOCKET-50302-70) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Faulty Overcurrent Trip Relay Device in Circuit Breakers for Engineered Safety Systems. (Florida Power Corp., St. Petersburg). 1 May 1973. 5p. Dep. NTIS $3.00.

4838 (DOCKET-50304-94) ZION STATION NUCLEAR POWER PLANT, UNIT 2. Fuel Densification. (Commonwealth Edison Co., Chicago, Ill.). 4 May 1973. 102p. (WCAP-8123). Dep. NTIS $7.25.

4839 (DOCKET-50305-78) KEWAUNEE NUCLEAR POWER PLANT.. Fuel Densification. (Wisconsin Public Service Corp., Green Bay). 24 Apr 1973. 1p. Dep. NTIS $3.00.

4840 (DOCKET-50305-79) KEWAUNEE NUCLEAR POWER PLANT. Inspection Report No. 050-305/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 1 May 1973. 15p. Dep. NTIS $3.00.

4841 (DOCKET-50309-107) MAINE YANKEE ATOMIC POWER STATION. Inspection Report No. 50-309/73-02. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 20 Mar 1973. 5p. Dep. NTIS $3.00.

4842 (DOCKET-50309-109) MAINE YANKEE ATOMIC POWER STATION. Plant Load Reduced to Below 75% Power Due to Loss of One in Four Circulating Pumps. (Maine Yankee Atomic Power Co., Westboro, Mass.). 19 Apr 1973. 1p. Dep. NTIS $3.00.

4843 (DOCKET-50309-110) MAINE YANKEE ATOMIC POWER STATION. Monthly Report 3-73, March 1973. (Maine Yankee Atomic Power Co., Westboro, Mass.). 26 Apr 1973. 34p. Dep. NTIS $3.75.

4844 (DOCKET-50309-111) MAINE YANKEE ATOMIC POWER STATION. Technical Specifications, Change No. 2. (Directorate of Licensing (AEC), Washington, D. C.). 30 Apr 1973. 3p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning reduced pressure and inlet temperature for the primary coolant system. (DCC)

4845 (DOCKET-50309-112) MAINE YANKEE ATOMIC POWER STATION. Quality Assurance Program. (Maine Yankee Atomic Power Co., Westboro, Mass.). 20 Apr 1973. 7p. Dep. NTIS $3.00.

4846 (DOCKET-50312-67) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Draft Environmental Statement, Comments of the State of California Not Included. (Resources Agency of California, Sacramento (USA)). 30 Mar 1973. 1p. Dep. NTIS $3.00.

4847 (DOCKET-50312-71) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Safety Related Circuit Breakers. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 25 Apr 1973. 6p. Dep. NTIS $3.00.

4848 (DOCKET-50312-72) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Nuclear Energy Liability Insurance for Special Nuclear Material License No. SNM-1333. (Sacramento Municipal Utility District, Calif.). 12 Apr 1972. 15p. Dep. NTIS $3.00.

4849 (DOCKET-50312-73) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Review of Control Circuits of Safety Related Equipment. (Sacramento Municipal Utility District, Calif.). 3 May 1973. 3p. Dep. NTIS $3.00.

4850 (DOCKET-50312-74) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Safety Analysis Report, Amendment 21. (Sacramento Municipal Utility District, Calif.). 7 May 1973. 160p. Dep. NTIS $10.00.
Revised and requested data are presented concerning the reactor site, core physics, cooling system, engineered safeguards, auxiliary systems, electrical system, radioactive waste disposal, test program, and piping systems. (DCC)

4851 (DOCKET-50313-74) ARKANSAS NUCLEAR ONE, UNIT 1. Engineered Safeguard Equipment, Circuit Breakers. (Arkansas Power and Light Co., Little Rock). 11 Apr 1973. 2p. Dep. NTIS $3.00.

4852 (DOCKET-50315-110) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Draft Environmental Statement, Comments of State of Michigan Department of Public Health. (Michigan Dept. of Public Health, Lansing (USA)). 10 Apr 1973. 2p. (DOCKET-50316-109). Dep. NTIS. $3.00.

4853 (DOCKET-50315-115) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on January 30-31, and February 1, 1973. (American Electric Power Service Corp., New York). 28 Mar 1973. 24p. (DOCKET-50316-114). Dep. NTIS $3.25.
Information on the quality assurance program at the Donald C. Cook Nuclear Plant, Units 1 and 2 is presented. (JWR)

4854 (DOCKET-50315-116) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Availability of Shutdown Funds. (Indiana and Michigan Electric Co., New York). 25 Apr 1973. 3p. (DOCKET-50316-115). Dep. NTIS $3.00.

4855 (DOCKET-50315-117) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 43. (Indiana and Michigan Power Co., New York). 1 May 1973. 33p. (DOCKET-50316-116). Dep. NTIS $3.75.
Revised and requested data are presented concerning electrical equipment, engineered safeguards, power conversion system, and environmental radiation monitoring program. (DCC)

4856 (DOCKET-50317-93) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 4 May 1973. 39p. (DOCKET-50318-90). Dep. NTIS $4.00.

4857 (DOCKET-50317-94) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 4p. (DOCKET-50318-91). Dep. NTIS $3.00.

4858 (DOCKET-50317-95) CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1. Inspection Report No. 50-317/73-05. (Directorate of Regulatory Operations (AEC), Newark N. J. Region I). 2 Apr 1973. 6p. Dep. NTIS $3.00.

4859 (DOCKET-50317-96) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 36. (Baltimore Gas and Electric Co., Md.). 27 Apr 1973. 397p. (Docket-50318-92). Dep. NTIS $3.00.
Revised and requested information on the safety analysis of high energy pipe ruptures outside containment and on the technical specifications for the Calvert Cliffs Nuclear Power Plant, Units 1 and 2, is presented. (JWR)

4860 (DOCKET-50317-97) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Inspection Reports Nos. 50 317/73-02 and 50-318/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 26 Mar 1973. 20p. (DOCKET-50318-93). Dep. NTIS $3.00.

4861 (DOCKET-50317-98) CALVERT CLIFFS NUCLEAR POWER PLANT, UNIT 1. Inquiry Report No. 50-317/73-01Q, Construction/Equipment Deficiency. Rusted Condition of Emergency Diesel Generators. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 30 Mar 1973. 3p. Dep. NTIS $3.00.

4862 (DOCKET-50317-99) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Quality Assurance Program. (Baltimore Gas and Electric Co., Md.). 3 May 1973. 2p. (DOCKET-50318-94). Dep. NTIS $3.00.

4863 (DOCKET-50317-100) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report,

Amendment 37. (Baltimore Gas and Electric Co., MD). 3 May 1973. 45p. (DOCKET-50318-95). Dep. NTIS $4.25.
Revised and additional data are presented concerning the electrical systems, power conversion system, accident analysis, and technical specifications. (DCC)

4864 (DOCKET-50317-101) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 4 May 1973. 35p. (DOCKET-50318-96). Dep. NTIS $3.75.

4865 (DOCKET-50321-77) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 32. (Georgia Power Co., Atlanta). 16 Apr 1973. 154p. Dep. NTIS $9.75.
Revised and requested information on the containment system, control system, instrumentation, and operations aspects at the Edwin I. Hatch Nuclear Plant, Unit 1, is presented. (JWR)

4866 (DOCKET-50321-78) EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 5p. (DOCKET-50366-39). Dep. NTIS $3.00.

4867 (DOCKET-50324-77) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Radiological Releases. (Carolina Power and Light Co., Raleigh, N. C.). 30 Apr 1973. 1p. (DOCKET-50325-78). Dep. NTIS $3.00.

4868 (DOCKET-50324-78) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 5p. (DOCKET-50325-79). Dep. NTIS $3.00.

4869 (DOCKET-50327-38) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 6p. (DOCKET-50328-36). Dep. NTIS $3.00.

4870 (DOCKET-50327-39) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Vendor Inspection Report No. 999-047/73-3. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 28 Mar 1973. 15p. (DOCKET-50328-37). Dep. NTIS $3.00.

4871 (DOCKET-50333-89) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 23 Feb 1973. 4p. Dep. NTIS $3.00.

4872 (DOCKET-50333-90) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Inspection Report No. 50-333/73-03. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 29 Mar 1973. 11p. Dep. NTIS $3.00.

4873 (DOCKET-50333-91) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Valve Wall Thickness. (Power Authority of the State of New York). 4 Apr 1972. 1p. Dep. NTIS $3.00.

4874 (DOCKET-50334-60) BEAVER VALLEY POWER STATION, UNIT 1. Final Safety Analysis Report, Amendment 1. (Duquesne Light Co., Pittsburgh, Pa.). 23 Apr 1973. 834p. Dep. NTIS $43.75.
Revised and requested information on the Beaver Valley Power Station, Unit 1 is presented under the following headings: site; containment system; buildings and equipment; engineered safeguards; power conversion system; radioactive waste disposal; radiation protection; personnel; and safety analysis. (JWR)

4875 (DOCKET-50334-63) BEAVER VALLEY POWER STATION, UNIT 1. Faulty Overcurrent Trip Delay Devices in Circuit Breakers for Engineered Safety Systems. (Duquesne Light Co., Pittsburgh, PA). 9 Mar 1973. 1p. Dep. NTIS $3.00.

4876 (DOCKET-50335-56) ST. LUCIE PLANT, UNIT 1. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 5p. Dep. NTIS $3.00.

4877 (DOCKET-50335-57) ST. LUCIE PLANT, UNIT 1. Inspection Report No. 50-335/73-2. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 13 Apr 1973. 18p. Dep. NTIS $3.00.

4878 (DOCKET-50336-55) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Faulty Overcurrent Trip Delay Devices in Circuit Breakers for Engineered Safety System. (Millstone Point Co., Hartford, Conn.). 22 Mar 1973. 1p. Dep. NTIS $3.00.

4879 (DOCKET-50338-61) NORTH ANNA POWER STATION, UNITS 1 AND 2. License Application. (Virginia Electric and Power Co., Richmond). 16 Mar 1973. 146p. (DOCKET-50339-59). Dep. NTIS $9.50.

4880 (DOCKET-50338-62) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 1. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 475p. (DOCKET-50339-60). Dep. NTIS $25.75.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning the plant layout and the reactor site. (DCC)

4881 (DOCKET-50338-63) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 2. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 606p. (DOCKET-50339-61). Dep. NTIS $32.50.
Information on the design criteria for the structures, components, equipment, and systems for the North Anna Power Station, Units 1 and 2, is presented. (JWR)

4882 (DOCKET-50338-64) NORTH ANNA POWER STATION, UNITS 1 AND 2. Applicant's Environmental Statement, Operating License Stage, Appendix K. (Virginia Electric and Power Co., Richmond). 30 Apr 1973. 24p. (DOCKET-50339-62). Dep. NTIS $4.00.
Revised and additional data are presented concerning the environmental effects of construction and operation of the North Anna Power Reactor Units 1 and 2. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

4883 (DOCKET-50338-65) NORTH ANNA POWER STATION, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 5p. (DOCKET-50339-63) Dep. NTIS $3.00.

4884 (DOCKET-50338-66) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 3. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 563p. (DOCKET-50339-65). Dep. NTIS $30.25.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning reactor design parameters and cooling system. (DCC)

4885 (DOCKET-50338-67) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 4. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 690p. (DOCKET-50339-66). Dep. NTIS $36.50.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning engineered safeguards, instrumentation, and control systems. (DCC)

4886 (DOCKET-50338-68) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 5. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 622p. (DOCKET-50339-67). Dep. NTIS $33.25.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning electrical systems, auxiliary systems, and power conversion systems. (DCC)

4887 (DOCKET-50338-69) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 6. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 444p. (DOCKET-50339-68). Dep. NTIS $24.25.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning radioactive waste management, radiation protection, operations aspects, and emergency plan. (DCC)

4888 (DOCKET-50338-70) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 7. (Virginia Electric and Power Co., Richmond). 3 Jan 1973. 489p. (DOCKET-50339-69). Dep. NTIS $26.50.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning initial tests and accident analysis. (DCC)

4889 (DOCKET-50338-71) NORTH ANNA POWER STATION, UNITS 1 AND 2. Final Safety Analysis Report, Volume 8.

(Virginia Electric and Power Co., Richmond). 3 Jan 1973. 432p. (DOCKET-50339-70). Dep. NTIS $23.75.
Information on the North Anna Power Reactor Units 1 and 2 is presented concerning technical specifications and quality assurance program. (DCC)

4890 (DOCKET-50340-7) SEABROOK NUCLEAR STATION, UNIT 1. Inspection Report No. 50-340/73-01. (Directorate of Regulatory Operations (AEC), Newark, N. J. Region I). 21 Mar 1973. 7p. Dep. NTIS $3.00.

4891 (DOCKET-50341-53) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. NDT of Cast Pumps and Valves Less Than 4 Inches Diameter. (Detroit Edison Co., Mich.). 17 Apr 1973. 2p. Dep. NTIS $3.00.

4892 (DOCKET-50341-54) ENRICO FERMI ATOMIC POWER PLANT, Unit 2. Inspection Report No. 050-341/73-04. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 2 Apr 1973. 7p. Dep. NTIS $3.00.

4893 (DOCKET-50341-55) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Vendor Inspection Report No. 999-036/73-01. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 2 Apr 1973. 7p. Dep. NTIS $3.00.

4894 (DOCKET-50341-57) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Vendor Inspection Audit Report No. 999-020/73-01. (Detroit Edison Co., Mich.). 16 Apr 1973. 2p. Dep. NTIS $3.00.

4895 (DOCKET-50344-61) TROJAN NUCLEAR PLANT. Safety Related Circuit Breakers. (Portland General Electric Co., Oreg.). 9 Apr 1973. 6p. Dep. NTIS $3.00.

4896 (DOCKET-50344-62) TROJAN NUCLEAR PLANT. Steps Taken to Correct Items Brought to Attention Following Inspection, January 29-February 1, 1973. (Portland General Electric Co., Oreg.). 22 Mar 1973. 29p. Dep. NTIS $3.50.
Information is presented concerning the torque testing procedures for nuts and bolts during the construction of Class 1 support structures. (DCC)

4897 (DOCKET-50344-63) TROJAN NUCLEAR PLANT. Draft Environmental Statement, Response to Agency Comments. (Portland General Electric Co., Oreg.). 27 Apr 1973. 10p. Dep. NTIS $3.00.

4898 (DOCKET-50346-58) DAVIS-BESSE NUCLEAR POWER STATION. Faulty Circuit Breaker Trips. (Toledo Edison Co., Ohio). 12 Mar 1973. 1p. Dep. NTIS $3.00.

4899 (DOCKET-50348-57) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 5p. (DOCKET-50364-48). Dep. NTIS $3.00.

4900 (DOCKET-50348-58) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Inspection Reports Nos. 50-348/73-1 AND 50-364/73-1 With Attached Inquiry Reports Nos. 50-348/73-1Q/CDR and 50-364/73-1Q/CDR: Damaged Power and Lighting Cable. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 27 Mar 1973. 17p. (DOCKET-50364-49). Dep. NTIS $3.00.

4901 (DOCKET-50348-59) JOSEPH M. FARLEY NUCLEAR PLANT, UNIT 1. Vendor Inspection Report No. 999-47/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 5 Apr 1973. 13p. Dep. NTIS $3.00.

4902 (DOCKET-50354-37) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Responses to Comments on Draft Environmental Statement. (Public Service Electric and Gas Co., Newark, N. J.). 19 Apr 1973. 36p. (DOCKET-50355-36). Dep. NTIS $4.00.

4903 (DOCKET-50354-38) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Delaware River Basin Commission Conditional Approval Regarding Water Availability. (Public Service Electric and Gas Co., Newark, N. J.). 19 Apr 1973. 10p. (DOCKET-50355-37). Dep. NTIS $3.00.

4904 (DOCKET-50354-39) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNIT 1. Draft Environmental Statement, Additional Responses to Comments. (Public Service Electric and GAS Co., Newark, N. J.). 2 May 1973. 12p. (DOCKET-50355-38). Dep. NTIS $3.00.

4905 (DOCKET-50358-46) WILLIAM H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Faulty Overcurrent Trip Delay Device in Circuit Breakers. (Cincinnati Gas and Electric Co., Ohio). 6 Apr 1973. 1p. Dep. NTIS $3.00.

4906 (DOCKET-50361-41) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Ocean Current Information. (Southern California Edison Co., Rosemead, Calif.). 12 Apr 1973. 359p. (DOCKET-50362-40). Dep. NTIS $20.00.

4907 (DOCKET-50367-38) BAILLY GENERATING STATION, NUCLEAR I. Inspection Report No. 050-367/73-01. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 6 Apr 1973. 13p. Dep. NTIS $3.00.

4908 (DOCKET-50367-39) BAILLY GENERATING STATION, NUCLEAR I. Vendor Inspection Report No. 999-036/73 01. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 2 Apr 1973. 8p. Dep. NTIS $3.00.

4909 (DOCKET-50369-39) MCGUIRE NUCLEAR STATION, UNIT 1. Vendor Inspection Report No. 999-36/73-02. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 28 Mar 1973. 14p. Dep. NTIS $3.00.

4910 (DOCKET-50374-34) LA SALLE COUNTY STATION, UNIT 2. Vendor Inspection Report No. 999-035/73-03. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 13 Apr 1973. 10p. Dep. NTIS $3.00.

4911 (DOCKET-50382-59) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Draft Environmental Statement, Comments of the United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 23 Apr 1973. 6p. Dep. NTIS $3.00.

4912 (DOCKET-50382-60) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 34. (Louisiana Power and Light Co., New Orleans). 26 Apr 1973. 15p. Dep. NTIS $3.00.
Additional information on the essential cooling water system for the Waterford Steam Electric Station, Unit 3, is presented. (JWR)

4913 (DOCKET-50382-61) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Emergency Core Cooling System Improvement Report. (Louisiana Power and Light Co., New Orleans). 30 Apr 1973. 2p. Dep. NTIS $3.00.

4914 (DOCKET-50382-62) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 35. (Louisiana Power and Light Co., New Orleans). 15 May 1973. 17p. Dep. NTIS $3.00.
Revised and requested information is presented concerning containment structure pressure analysis. (DCC)

4915 (DOCKET-50387-33) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Draft Environmental Statement, Responses to Government Agency Comments. (Pennsylvania Power and Light Co., Allentown). 12 Apr 1973. 8p. (DOCKET-50388-32). Dep. NTIS $3.00.

4916 (DOCKET-50387-34) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 10. (Pennsylvania Power and Light Co., Allentown). May 1973. 12p. (DOCKET-50388-33). Dep. NTIS $3.00.
A design guide is presented on the analysis of pipe failures outside the containment structure. (DCC)

4917 (DOCKET-50387-35) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Vendor Inspection Report No. 999-035/73-02. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 27 Mar 1973. 11p. (DOCKET-50388-34). Dep. NTIS $3.00.

4918 (DOCKET-50387-37) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Washington, D.C. (USA)). 4 May 1973. 6p. (DOCKET-50388-36). Dep. NTIS $3.00.

4919 (DOCKET-50389-11) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 1. (Florida Power and Light Co.). 15 May 1973. 477p. Dep. NTIS $26.00.
Information on the St. Lucie Power Reactor Unit 2 is presented concerning general design parameters and the reactor site. (DCC)

4920 (DOCKET-50389-12) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 2. (Florida Power and Light Co.). 21 May 1973. 416p. Dep. NTIS $23.00.

Information on the St. Lucie Power Reactor Unit 2 is presented concerning the design of structures, components, and equipment. (DCC)

4921 (DOCKET-50389-13) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 3. (Florida Power and Light Co.). 21 May 1973. 372p. Dep. NTIS $20.75.
Information on the St. Lucie Power Reactor Unit 2 is presented concerning general design parameters and the cooling system. (DCC)

4922 (DOCKET-50389-14) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 4. (Florida Power and Light Co.). 21 May 1973. 566p. Dep. NTIS $30.50.
Information on the St. Lucie Power Reactor Unit 2 is presented concerning engineered safeguards, instrumentation, and control system. (DCC)

4923 (DOCKET-50389-15) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 5. (Florida Power and Light Co.). 21 May 1973. 384p. Dep. NTIS $21.25.
Information on the St. Lucie Power Reactor Unit 2 is presented concerning electric power systems and auxiliary systems. (DCC)

4924 (DOCKET-50389-16) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 6. (Florida Power and Light Co.). 21 May 1973. 274p. Dep. NTIS $15.75.
Information on the St. Lucie Power Reactor Unit 2 is presented concerning the power conversion system, radioactive waste management, and radiation protection. (DCC)

4925 (DOCKET-50389-17) ST. LUCIE PLANT, UNIT 2. Preliminary Safety Analysis Report, Volume 7. (Florida Power and Light Co.). 21 May 1973. 349p. Dep. NTIS $19.50.
Information on the St. Lucie Power Reactor Unit 2 is presented concerning operations aspects, initial tests, and accident analysis. (DCC)

4926 (DOCKET-50390-37) WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2. Faulty Overcurrent Trip Delay Device in Circuit Breakers for Engineered Safety Systems. (Directorate of Regulatory Operations (AEC), Atlanta, GA. (USA). Region II). 21 Feb 1973. 6p. (DOCKET-50391-37). Dep. NTIS $3.00.

4927 (DOCKET-50410-28) NINE MILE POINT NUCLEAR STATION, UNIT 2. Draft Environmental Statement, Comments of United States Department of the Interior. (Department of the Interior, Washington, D. C. (USA)). 23 Apr 1973. 6p. Dep. NTIS $3.00.

4928 (DOCKET-50412-8) BEAVER VALLEY POWER STATION, UNIT 2. Department of Justice Advises Antitrust Hearing Not Required. (Department of Justice, Washington, D. C. Antitrust Div.). 20 Apr 1973. 8p. Dep. NTIS $3.00.

4929 (DOCKET-50412-9) BEAVER VALLEY POWER STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 4. (Duquesne Light Co., Pittsburgh, Pa.). 27 Apr 1973. 602p. Dep. NTIS $32.25.
Revised and requested information on the Beaver Valley Power Station, Unit 2, is presented under the following headings: site; buildings; cooling system; engineered safeguards; instrumentation; reactor control system; electrical system; auxiliary systems; and safety analysis. (JWR)

4930 (DOCKET-50413-15) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Apr 1973. 308p. (DOCKET-50414-15). Dep. NTIS $17.50.
The environmental effects of construction and operation of the Catawba Power Reactor Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (DCC)

4931 (DOCKET-50413-16) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Department of Justice Recommendation of an Antitrust Hearing. (Department of Justice, Washington, D.C. Antitrust Div.). 1 May 1973. 2p. (DOCKET-50414-16). Dep. NTIS $3.00.

4932 (DOCKET-50413-17) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 7. (Duke Power Co., Charlotte, NC). 4 May 1973. 324p. (DOCKET-50414-17). Dep. NTIS $18.25.
Revised and requested data are presented concerning auxiliary systems, electrical system, instrumentation, radioactive waste system, power conversion system, and mechanical structures. (DCC)

4933 (DOCKET-50413-18) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Inspection Reports Nos. 50-413/73-1 and 50-414/73-1. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 27 Apr 1973. 20p. (DOCKET-50414-18). Dep. NTIS $3.00.

4934 (DOCKET-50416-22) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 4. (Mississippi Power and Light Co., Jackson (USA)). 20 Apr 1973. 1374p. (DOCKET-50417-22). Dep. NTIS $60.00.
Revised and requested information on the Grand Gulf Nuclear Station, Units 1 and 2 is presented under the following main headings: plant design; site; buildings and equipment; containment system; engineered safeguards; instrumentation; control system; electrical system; auxiliary systems; power conversion system; radioactive waste disposal; radiation protection; personnel; and operations aspects. (JWR)

4935 (DOCKET-50416-23) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 6. (Mississippi Power and Light Co., Jackson (USA)). 30 Apr 1973. 452p. (DOCKET-50417-23). Dep. NTIS $24.75.
Revised and additional information is presented concerning pipe breaks outside the containment structure, steam turbine failure, accident analysis, and stress analysis of equipment and structures. (DCC)

4936 (DOCKET-50424-12) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Preliminary Safety Analysis Report, Amendment 1. (Georgia Power Co., Atlanta). 27 Apr 1973. 47p. (DOCKET-50425-12; DOCKET-50426-12; DOCKET-50427-12). Dep. NTIS $4.50.
Revised and additional data are presented concerning the nuclear service water and component cooling water systems. (DCC)

4937 (DOCKET-50424-14) ALVIN W. VOGTLE NUCLEAR PLANT, UNITS 1, 2, 3, AND 4. Department of Justice Recommendation with Respect to Antitrust Hearing. (Department of Justice, Washington, D. C. Antitrust Div.). 9 May 1973. 2p. (DOCKET-50425-14; DOCKET-50426-14; DOCKET-50427-14). Dep. NTIS $3.00.

4938 BACKFITTING OF LICENSED NUCLEAR POWER PLANTS. An Introduction to Engineering Problems. Franzen, L. F. (Technische Ueberwachungsvereine eV, Cologne). (1972). vp. (In German).
From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).
As seen from the technical point of view, the backfitting of nuclear installations according to the advances made in nuclear science and technology is not only desirable but seems to be achievable to a certain extent. On the other hand it can be said that owing to the safety philosophy that has been followed so far, changes in the environment of nuclear installations most probably will have a lesser effect on operating plants than has been thought up to now. New criteria in the safety assessment are not likely to be applied to operating plants but rather to plants to be installed in the future. (GF)

4939 MULTIPLE FUNCTIONS EXERCISED BY EXPERTS. Kellermann, O. (1972). vp. (In German).
From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).
Since the founding of the Technical Inspection Associations (TUEVs), their experts have been active for a variety of clients and institutions: They act as advisors for industrial undertakings in the field of safety technology, they give expert opinions for administrative authorities, or they exercise their function as officially appointed experts on behalf of various Federal authorities. They are economically and technically independent and play an important part in the licensing of nuclear facilities where they contribute to reducing the time required for the licensing procedure. (GF)

4940 GERMAN ATOMIC ENERGY LAWS: FUTURE DEVELOPMENTS. Pfaffelhuber (Bundesministerium fuer Bildung und Wissenschaft, Bonn). (1972). vp. (In German).
From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).
Recent developments in the Atomic Energy Law and related ad-

ministrative regulations are examined. The following items are discussed: (1) The problem of incorporating the procedures in connection with the drawing up of construction plans and time schedules for the installation of nuclear power plants into the body of the Atomic Energy Law. (2) The radiation protection ordinances and their position within the framework of the licensing procedure in accordance with paragraph 7 of the Atomic Energy Law and new findings in the field of nuclear science and technology which have to be taken into consideration. (3) Official licenses permitting the extension of modification of nuclear installations for the purpose of backfitting nuclear installations either under construction or already in operation. (4) The draft of new provisions in the field of radiation protection. (5) The promulgation of a new x-ray decree. (6) The Paris Convention on third party liability in the field of nuclear energy and the draft of an amendment to the German Atomic Energy Law, concerning third party liability in the FRG. (GF)

4941 BACKFITTING OF LICENSED NUCLEAR POWER PLANTS. The Procedure Practiced in the USA. Franzen, L. F. (Technische Ueberwachungsvereine eV, Cologne). (1972). vp. (In German).

From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

In the United States it is generally accepted that the backfitting of licensed nuclear power plants belongs to the responsibility of the operators. The function of the AEC in this continuous process is to induce, inspect, license, and control the realization of any such modifications as far as these will bring about a substantial, additional safeguard for the protection of the general public. The underlying principle is to ensure that old plants will be modified as far as is practicable in order to keep abreast with the advances made in nuclear science and technology. Due to the fact that the pertinent regulations and provisions are formulated in a rather general way, the AEC is almost unrestricted in its authority to demand and even enforce the modification of an old plant if this is considered inevitable. However, the AEC is well aware of the responsibility it has assumed and has been very careful in the exercise of its powers. This is why it has been possible so far to solve all problems arising in connection with the backfitting of a plant in complete agreement with the manufacturers as well as the operators. (GF)

4942 BUILDING RESTRICTIONS ZONES FOR NUCLEAR ENERGY FACILITIES: PROBLEMS IN CONNECTION WITH THE ATOMIC ENERGY LAW AND THE LAW ON PROTECTION AGAINST EMISSIONS. Vollmer, H. (Univ., Muenster, Ger.). (1972). vp. (In German).

From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

It is becoming more and more difficult in West Germany to find appropriate, safe sites for nuclear installations in the densely populated and industrial areas of this country. Additional problems encountered in this field are arising from the fact that changes in the environment of operating nuclear facilities (as, for instance, the subsequent installation of other industrial plants in the neighbourhood of power plants) may bring about an aggravation of risks in the operation of the nuclear plants. Hence the question arises whether nuclear power plants and other nuclear installations should be surrounded by a building restriction zone in order to protect the general public and the installations from undue hazards. The problem is discussed in the light of the present Atomic Energy Law and it is suggested that special provisions relating the establishment of such restricted areas be introduced. (GF)

4943 DISCRETIONARY POWER, THE MARGIN OF JUDGEMENT, AND THE BURDEN OF PROOF RESTING WITH THE PARTIES CONCERNED IN LICENSING PROCEDURES ACCORDING TO THE ATOMIC ENERGY LAW. Mahlmann, W. (Univ., Muenster, Ger.). (1972). vp. (In German).

From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

Despite the wording of article 7 of the Atomic Energy Law and in spite of the legislative intent, the licensing of plants under article 7 has to be considered as an act of administration, and applicants are therefore legally entitled to the granting of a license provided that the requirements are fulfilled. During the verification of licensing requirements, the licensing authorities must have a certain amount of free hand in the interpretation of general legal terms in article 7 of the Atomic Energy Law, (as, e.g., "required precautions against damages," or "any other influence exerted by a third party"). The principles developed for the examination of decisions made within the margin of judgement of the authorities, especially the principle of proportionateness, can be applied accordingly in the judicial examination of decisions made by the licensing authorities. According to the legal provisions, the burden of the proof of facts considered as a danger to the general public by the licensing authority rests with the authority, whereas the applicant has to prove evidence that the design of the plant to be installed guarantees safe operation. (GF)

4944 BACKFITTING OF LICENSED NUCLEAR POWER PLANTS. Compensation for Damages and Legal Aspects. Scharnhoop (Univ., Muenster, Ger.). (1972). vp. (In German).

From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

The operator of a nuclear facility cannot refer to the legal validity of an earlier granted license when applying for official license to modify the operating plant if such a modification will entail an aggravation or alteration of risks inherent in the particular plant. In this case, the licensing authority has the right to demand that the plant be modified to comply with the latest safety standards available at the time of the granting of the modification license without payment of compensation. If there is no danger of an aggravation of risks due to the modification of the plant, or of an alteration of risks, the licensing authority is authorized to demand the backfitting of the plant under Paragraph 17 of the Atomic Energy Law. This, however, will not establish a claim for compensation for damages on the part of the operator unless the restrictions imposed upon him will be equivalent to a revocation of the previously granted license and if paragraph 18 section 2 of the Atomic Energy Law is to be applied. (GF)

4945 TECHNICAL ASPECTS OF SAFETY ENGINEERING FOR THE PROTECTION OF NUCLEAR FACILITIES FROM HYPOTHETICAL EXTERNAL EFFECTS. Schwarzer, W. (Technische Ueberwachungsvereine eV, Cologne). (1972). vp. (In German).

From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

Known external effects are reduced to three basic types of events: (1) Vibration of the overall plant (due to earthquakes or shock waves in the soil caused by explosions). (2) Loads affecting the whole plant (such as those due to wind, snow or blast waves from explosions in adjacent industrial installations). (3) Concentrated point loads (due to aircraft crashes or to fragments being scattered around after an explosion outside the plant). After an analysis of the consequences of these events, it is concluded that combining the various engineered safety measures to protect plants from the various external effects to one standard design which would be required also for those plant sites where the occurrence of these events seems to be hypothetical at the time of the licensing of a plant would be more efficient than other safety measures that will have to be taken after a possible future change in the environment of a plant. (GF)

4946 MULTIPLE FUNCTIONS EXERCISED BY TECHNICAL EXPERTS IN THE ADMINISTRATION OF THE ATOMIC ENERGY LAW AND IN LEGAL PROCEEDINGS. Lukes, R. (Univ., Muenster, Ger.). (1972). vp. (In German).

From 1st symposium on atomic energy law; Muenster, Germany (7 Dec 1972).

Technical experts have to exercise multiple functions as they deal with a variety of clients and institutions. As contractual experts for manufacturers and operators of nuclear installations, they are testing the components, equipment, and systems which then have to be examined by the appropriate licensing authority that is responsible for the inspection of these systems to be installed in new plants, and for the checking of safety reports. In most cases, the licensing authority will take its decisions in accordance with the expert opinion given by the same technical experts. The same is true for the authority supervising the construction work subsequent to the licensing of plants, and even applies to legal proceedings where the decisions to be taken will depend on the expert opinion of the very same experts. The problems arising from this situation are discussed in detail in the light of both the administrative law and the adjective law. (GF)

GENERAL

Civilian Defense

4947 (ORNL-4818) PASSIVE-ACTIVE DEFENSE STUDIES FOR THE DETROIT METROPOLITAN AREA. Final Report. Haaland, C. M.; Heath, M. T. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 277p. Dep. NTIS $3.00.

Potential blast shelter sites found by Bechtel Corporation by on-site inspection were evaluated for their effectiveness against a threat with a short warning time, such as a submarine launched ballistic missile (SLBM) threat. It was found that, even under the best conditions for movement of population to shelter, the shelters were spaced too far apart to be effective against such a threat. Furthermore, sufficient anti-ballistic missiles (ABM) to hold off the attack long enough for people to get into these shelters would require a budget in excess of $3 billion for Detroit alone. Shelters constructed by blast-slanting techniques and averaging about 200-person capacity were found to minimize fatalities against a variety of attacks. A combination of ABM and 200-person shelters generally provides better protection than either shelters or ABM alone. Curves of cost-per-life saved vs. mid-lethal over-pressure (MLOP) showed minima ranging from 25 to 40 psi MLOP. Approximately 36,000 shelters of 200-person capacity would be required for the 1980 Detroit standard metropolitan statistical area (SMSA) population, with an average spacing between shelters inversely proportional to the square root of the local population density. (auth)

Energy Utilization and Economics

4948 (CONF-720975-) PROCEEDINGS OF THE WORKSHOP ON NUCLEAR ENERGY, THE ENVIRONMENT, AND ENGINEERING EDUCATION, HELD IN WASHINGTON, D. C., SEPTEMBER 28-29, 1972. Murray, R. L. (Ed.). (North Carolina State Univ., Raleigh. Dept. of Nuclear Engineering). 1972. 43p. Dep. NTIS $4.00.

Goals and directions for nuclear education in the 1970's in relation to national needs for energy and environmental quality were discussed at the workshop. Purposes of the workshop were to define the needed contribution of nuclear engineering education in response to the dual challenge of meeting the nation's future energy needs and, at the same time, protecting and enhancing the quality of the natural environment; to weigh priorities among suggested alternative courses of action to meet defined education and manpower goals; and to develop plans for cooperative action by the participating academic, industrial, and governmental groups. (JCW)

4949 (CONF-730328-1) STATE-OF-THE-ART OF ENERGY CONVERSION: TODAY AND TOMORROW. Burwell, C. C. (Oak Ridge National Lab., Tenn.). 1973. 18p. Dep. NTIS $3.00.

From APPA Engineering and Operations Workshop; Knoxville, Tennessee, USA (12 Mar 1973).

4950 (NP-19729) ASSESSMENT OF GEOTHERMAL ENERGY RESOURCES. (Department of the Interior, Washington, D. C. (USA)). 25 Sep 1972. 87p.

Geothermal resources in the USA could provide a significant part of the electrical energy needs within the next few decades, especially in the western states, Hawaii, and Alaska, if it were developed to its full potential. It is thought that at least 19,000 MW of generating capacity could be installed by 1985 using technology presently available, and more than 75,000 MW could be installed by 2000 with a successful research program. With a larger research program, geothermal energy could be supplying 132,000 MW and by 1985, and 395,000 MW by the 2000. Geothermal energy could have a significant potential for direct use in industrial processes, space heating, agriculture, refrigeration, the production of fresh water by desalination, and the production of mineral byproducts. (JCW)

4951 (ORNL-EIS-73-52(Vol.1)(No.4) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.) (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 35p. Dep. NTIS $3.75.

In general, research is covered on the following: energy sources, electric power (generation, supply and demand, transmission, environmental effects, and use), and energy (production, consumption, supply and demand, and policy). The research publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, progress reports, symposium papers and proceedings, monographs, and books published within the past two years. This bibliography includes 127 abstracts. (JCW)

4952 (TID-26319) BROWN COAL SURFACE MINING AND LAND RESTORATION IN GERMANY: AN EXAMPLE OF ENLIGHTENED LAND STEWARDSHIP. Nephew, E. A. (Oak Ridge National Lab., Tenn.). 1972. 14p. Dep. NTIS $3.00.

A study was made of the procedures employed in the Rhineland brown coal district of the Federal Republic of Germany to recover brown coal from large, open pit mines, and to restore the mined land area to useful, productive purposes. The extraction, restoration technologies, and the state regulatory and planning aspects are described. Some elements of the German surface mining and land reclamation technologies may be applicable to USA strip-mining in spite of important differences in the climate, terrain, and geological features of the coal-bearing regions of the two countries. The methods in the Federal Republic of Germany are well suited for mining in North Dakota, Illinois, and in northern Canada, but not in the Appalachian contour mining. Their methods for establishing vegetation on disturbed land areas should be valuable and useful in the USA. The findings were delivered before the joint hearing of the Subcommittee on the Environment and the Subcommittee on Mines and Mining of the House Committee on Interior and Insular Affairs. (JCW)

4953 PROBLEMS OF OUR PHYSICAL ENVIRONMENT: ENERGY, TRANSPORTATION, POLLUTION. Priest, J. Addison Wesley Series in Physics. Reading, MA; Addison Wesley Publishing Company (1973). 403p.

This book evolved from a course taught by the author at Miami Univ. (Ohio). The correlations of the resources of the Earth to the environment are discussed in the book. The chapters are entitled, Energy and Power: Principles, Demands, and Outlook; Electric Energy: Physical Models, By-Products, and Alternatives; Thermodynamics: Principles and Environmental Applications; Nuclear-Fueled Electric Power Plants: Physics, Pollution, and Outlook; Electric Energy Technology for the Future; Motor Vehicles: Problems and Alternatives; Sound from Motor Vehicles: An Exercise in Noise Pollution; Mass Transportation: Necessity and New Technology; Energy and Resources: Remote Sensing and Materials Recycling. Several problems (exercises) are included at the end of each chapter. (JCW)

4954 1970 NATIONAL POWER SURVEY, FEDERAL POWER COMMISSION. Part I. A Report by the Federal Power Commission. Washington, DC; Federal Power Commission (1971). 253p. GPO $4.25.

Work was begun in the fall of 1964 on the survey with the appointment of an executive advisory committee, an advisory committee on underground transmission, a committee on reliability of bulk power supply, and six regional advisory committees to aid in load growth analysis, coordination among utilities, studies of increased power supply, planning for additional generating facilities, and reliability of bulk power supply. Later, technical advisory committees on generation, transmission, distribution, and load forecasting methodology and a task force on environment were established. The Federal Power Commission has had the aid and cooperation of all segments of the US electric power industry, many governmental agencies, and concerned individuals. The report projects electric load growth over the next twenty years, and discusses changing power technology; growing concerns for all developments, including use of resources and various impacts on air, water, and land; increasing problems in meeting schedules for needed new power facilities; power plant fuel supply problems; and the probable effect of these on the cost of power. Part I contains the report of the Commission and the independent report of the Task Force on Environment. Part II and Part III contain the reports of the six regional advisory committees. Part IV contains the reports of the technical advisory committees on generation, transmission, distribution, and load forecasting methodology. (JCW)

4955 1970 NATIONAL POWER SURVEY, FEDERAL POWER COMMISSION. Part II. Advisory Reports to the Federal Power Commission. Washington, DC; Federal Power Commission (1971). 283p. GPO $6.00.

Advisory reports to the Federal Power Commission prepared by the Northeast Regional Advisory committee, the East Central Regional Advisory Committee, the Southeast Regional Advisory Committee, and the Fossil Fuel Resources Committee comprise Part II of the 1970 National Power Survey. Projections for the years 1970 to 1990 for the three regions are presented. The Fuel Resources Committee reports in depth on the requirements and

costs for electric generation in Eastern United States. All facets of electric energy generation dealing with coal, natural gas, residual oil, and nuclear fuels are surveyed. The effect of air pollution control on fuel availability and cost is summarized. (JCW)

4956 SVERKHPROVODNIKI V ENERGETIKE. (Superconductors in Power). Venikov, V. A. Moscow; Energiya (1972). 120p.

Including an introduction, in which some statistics of Soviet electric power are given together with an explanation of the advantages of superconductivity, the book is divided into four chapters. The first deals with superconducting electrical machinery, containing discussions of superconducting solenoids, superconducting ac generators, hyper- and superconducting ac motors, superconducting dc machinery, and the prospects of superconductivity in the Soviet electrical power scheme. The illustrations in this chapter are predominantly line drawings showing the machines discussed in cross section; there are three photographs, one of a Nb–Zr solenoid of 2.3 teslas, the second of a 1.8 tesla solenoid, and the third of the cryostat in a 37-kW unipolar motor. Chapter 2 is devoted to cryogenic transformers, with a detailed exposition of their design and operational peculiarities as well as their technical characteristics. The third chapter deals with cryogenic power cables, and the fourth with superconductive power storage devices. Factual text discussions are devoted to economic as well as technical factors. The monograph should prove a good handbook for the superconductive power engineer. (JPRS)

4957 TECHNICAL ALTERNATIVES FOR ENERGY MANAGEMENT. Freedman, S. I. (Univ. of Pennsylvania, Philadelphia). Energy Convers.; 13: No. 2, 57-65(Apr 1973).

The current energy management situation is presented in terms of the aspects limiting present practice. The conversion technologies available and being developed for the production of energy forms suitable for consumption from basic resources are summarized as technical alternatives. Options for continuing present trends in benefits of energy utilization include: development of processes to use new energy sources (U-238, Th-232, deuterium, gasified coal, geothermal, and solar), more efficient power generation from present fuels (topping cycles, MHD and higher temperature gas turbines), and more efficient utilization of energy and power in the consumption process. All of these alternatives require substantial investment in capital resources, engineering of products and systems with long term performance in mind, and more comprehensive planning of the entire energy utilization process. (auth)

Information Handling

4958 (UCID-30057) HIDDEN SURFACE PROCESSING. Archuleta, M. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Mar 1973. Contract W-7405-eng-48. 20p. Dep. NTIS $3.00.

Since there are many ways that a user may wish to represent his set of data, a low-level FORTRAN routine has been written to allow him the facility for producing a computer-generated halftone or line-drawing picture without having to conform to a particular data structure. The only criterion that must be observed is that the object description be in terms of polygons and edges. (auth)

4959 (UCID-30058) INTERACTIVE SURFACE PLOTTING. Archuleta, M. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Mar 1973. Contract W-7405-eng-48. 9p. Dep. NTIS $3.00.

This subroutine will enable a user to interactively display a three-dimensional surface. The user can have the option of having the surface displayed on the TMDS, written to disk as a dd80 picture, written to disk as a grey-level picture, or typed on the teletype as a pseudogrey-level picture. The input to the subroutine is very similar to the dd80 routines that handle contour plotting. Interactivity is achieved by the user being able to rotate, scale, and translate the three-dimensional surface. The hidden surfaces are removed from the display. The user can also transform the surface in such a way as to go inside the object since three-dimensional clipping is performed. (auth)

Law

Refer also to abstract 2580.

4960 (CONF-721030–, pp 8-13) AEC POSTURE REGARDING FEDERAL, STATE, AND LOCAL POLLUTION CONTROL REGULATIONS. Schoen, A. (Atomic Energy Commission, Washington, D. C.). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

Executive Order 11507, which was signed by the President on February 4, 1970, describes the policy and objectives of the Federal Government with respect to the prevention, control, and abatement of air and water pollution at Federal facilities. The Executive Order requires that Federal agencies comply with air and water pollution control standards which are prescribed by the Executive Order, those which were established pursuant to the Executive Order, and those which are adopted by the states and approved by the Federal Government (EPA) pursuant to the Clean Air Act and the Federal Water Pollution Control Act. AEC Manual Chapter 0510, which implements the Executive Order, sets forth AEC policy with respect to pollution control as follows: The AEC, in accordance with provisions of Executive Order 11507, Prevention, Control, and Abatement of Air and Water Pollution at Federal Facilities, shall participate with other Federal agencies in the nationwide effort to improve air and water quality through the prevention, control, and abatement of pollution which could result from activities and operations at buildings, facilities and other property owned by AEC; AEC operations shall comply with the requirements and standards contained in and prescribed by the Executive Order, as a minimum and, in addition, shall continue to follow the long-established AEC policy and practice of controlling potential sources of pollution as far below established standards as practical, considering both technology and economics. The specific Federal standards and requirements for air and water pollution control and for the discharge of radioactivity with which AEC facilities must comply are discussed. (CH)

4961 (CONF-721030–, pp 14-16) FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972 AND THEIR IMPACT ON AEC OPERATIONS. Greenleigh, S. H. (Atomic Energy Commission, Washington, D. C.). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

The 1972 Federal Water Pollution Control Act Amendments set a national goal of eliminating all pollutant discharges into U. S. waters by 1985 and an interim goal of making the waters safe for fish, shellfish, wildlife, and people by July 1, 1983. The impact of this legislation on AEC operations is discussed briefly. (CH)

4962 (CONF-721030–, pp 17-28) ENVIRONMENTAL IMPACT STATEMENT: NEW AEC GUIDELINES. Pennington, W. H. (Atomic Energy Commission, Washington, D. C.). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

The National Environmental Policy Act of 1969 (NEPA) requires a detailed environmental impact statement for major Federal actions significantly affecting the quality of the human environment. These are commonly referred to as 102(2) (c) statements which is the section in the Act that specifically spells out the requirements for the statements. Guidelines covering the requirements for the impact statements were issued by the Council on Environmental Quality (CEQ) in April 1971. Guidelines were issued by the AEC for the preparation of statements on operations projects and programs early after the implementation of NEPA, and IAD 0510-22 was issued May 28, 1970, and IAD 0510-25 was issued July 9, 1971 revising the first guidelines. The most recent revision was IAD 0510-29 issued July 6, 1972. The new guidelines identify those AEC actions requiring environmental statements and spell out the internal AEC review procedure for the preparation and issuance of the statements. It also sets requirements providing for timely public information on proposals for legislation and other major actions significantly affecting the quality of the human environment, including procedures responsive to the CEQ guidelines. Detailed guidance for the preparation of AEC environmental statements is included in the guidelines. A list of 21 final statements and two drafts in the process of being finalized is included. (CH)

4963 PUBLIC WORKS FOR WATER, POLLUTION CONTROL, AND POWER DEVELOPMENT AND ATOMIC ENERGY COMMISSION APPROPRIATIONS FOR FISCAL YEAR 1973. Hearings Before a Subcommittee of the Committee on Appropriations, United States Senate, Ninety-Second Congress, Second Session on an Act Making Appropriations for Public Works for Water, Pollution Control, and Power Development, Including the Corps of Engineers-Civil, the Panama Canal, the Federal Water Quality Administration, the Bureau of Reclamation, Power Agencies of the Department of the Interior, the Tennessee Valley Authority, the

Atomic Energy Commission, and Related Independent Agencies and Commissions for the Fiscal Year Ending June 30, 1973, and for Other Purposes. [Part 3. Washington, DC; Atomic Energy Commission (1972). 995p.]

Hearings conducted from April 20 to May 18, 1972 by the US Senate Subcommittee of the Committee of Appropriations on the subject of A.E.C. operating funds for fiscal year 1973 are reported verbatim. (LCL)

4964 ATOMIC ENERGY LEGISLATION THROUGH NINETY SECOND CONGRESS, SECOND SESSION, JOINT COMMITTEE ON ATOMIC ENERGY, CONGRESS OF THE UNITED STATES, MARCH 1973. Washington, DC; Joint Committee on Atomic Energy (1973). 412p. GPO $2.35.

The Atomic Energy Act of 1954, to amend the act of 1946, is presented in nineteen chapters in Part I. AEC authorization acts (with amendments) are detailed from fiscal year 1956 to 1973 in Part II. In Part III, proceedings are given for cooperation with the European Atomic Energy Community. Part IV deals with the International Atomic Energy Agency Participation Act of 1957. In Part V, the Atomic Energy Community Act of 1955, as amended, provides for the establishment of local self-government at the communities of Oak Ridge, Tennessee, and Richland, Washington, and provides for the disposal of federally owned properties of such communities. Information in 25 appendixes include: index to legislative history of Atomic Energy Act of 1954 and amendments; Atomic Energy Act of 1946, as amended; index to legislative history of Atomic Energy Act of 1946 and amendments; cross reference charts—Atomic Energy Acts of 1946 and 1954; appropriations for the atomic energy program of military appropriations (M.E.D.) and fiscal years 1947 to 1973; executive order 9816 (transferring properties and personnel from Manhattan Engineer District to AEC); Los Alamos retrocession; Atomic Weapons Rewards Act of 1955; AEC Headquarters Act; nuclear-powered merchant ship authorization; titles and jurisdiction to lands; Livermore retrocession; community support facilities, Los Alamos, N. Mex.; agreement for cooperation with government of France; Nuclear Test Ban Treaty; interoceanic canal study; exchange of Hanford lands; S. Res. 179 relating to nonproliferation of nuclear weapons; Nonproliferation Treaty; transfer of Otowi section land; Treaty on Outer Space; Seabeds Treaty; Interior Department's participation in MWD desalting project; executive orders concerning international atomic cooperation; and index to Atomic Energy Act of 1954, as amended. (JCW)

Management

4965 (CONF-721030–, pp 148-152) MAKING A WASTE DISPOSAL OPERATION PAY. Creswell, J. L. (Mason and Hanger-Silas Mason Co., Inc., Burlington, IA). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

A sanitary land fill operation was initiated at the Burlington AEC Plant and Iowa Army Ammunition Plant on 15 September 1969 after open refuse burning was banned in the state of Iowa. A salvage program was initiated when it became apparent that the first trench was being filled much faster than expected. Initial items to be salvaged and sold included banding steel and corrugated cardboard. During the last half of FY71, the Government netted $34,300.00 from the sale of 725 tons of salvaged scrap. This salvage program has extended the useful life of a trench from three to six months to one year. (auth)

4966 (CONF-721030–, pp 167-183) LOW-COST INCINERATOR UNITS FOR THE DISPOSAL OF WASTE GRAPHITE AND OILS. Boback, M. W. (National Lead Co. of Ohio, Cincinnati). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

This paper briefly describes two, locally built, low-cost units used for the incineration of waste graphite and oils generated in a uranium production facility. Both units can operate continuously with low maintenance and low operating costs. Prior to the fabrication of these burners, scrap graphite was buried and used oil was stored in drums with a small amount used for dust control on dirt roads. (auth)

4967 (CONF-721030–, pp 184-212) NON-RADIOACTIVE WASTE OIL DISPOSAL. Commander, J. C. (Aerojet Nuclear Co., Idaho Falls, ID). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

This paper is concerned with non-radioactive waste oil storage, collection, and disposal practice at the National Reactor Testing Station (NRTS). Alternative disposal techniques are considered including cost trade off and environmental impact. The need for revised legislation to improve the economic climate relating to rerefining of used oil is discussed. (auth)

4968 (CONF-721030–, pp 213-220) CLASSIFIED WASTE DISPOSAL: OAK RIDGE Y-12 PLANT. Breman, P. J. (Oak Ridge Y-12 Plant, TN). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

The Y-12 Plant generates approximately 2000 pounds of dry waste per day. This material consists of paper in loose leaf or book form, IBM cards and printout sheets, typewriter ribbons, carbon paper, bound booklets, photographs, photographic plates, engravings, offset plates, and glass photographic slides. Fasteners include paper clips, rubber bands, wire staples, Acco fasteners, and binders. A gas-fired incinerator to destroy dry classified waste was replaced with a hammermill paper disintegrator. The throughput is increased 70 percent and the time consumed is reduced 75 percent. (auth)

4969 (CONF-721030–, pp 221-241) DISPOSAL OF WASTE EXPLOSIVES. Honea, F. I. (Mason and Hanger-Silas Mason Co., Inc., Amarillo, TX). Feb 1973.

From AEC pollution control conference; Oak Ridge, Tennessee, USA (25 Oct 1972).

In proceedings of AEC pollution control conference, Oak Ridge, Tennessee, October 25–27, 1972.

Progress in the fields of incineration and biological degradation of explosives to eliminate present practice of open burning of explosives is reported. (auth)

4970 (JUL-Bibl.-17) LITERATURE SOURCES FOR PURE AND APPLIED SCIENCE. (Kernforschungsanlage, Juelich (West Germany)). Nov 1972. 530p. (In German). Dep. NTIS (U. S. Sales Only) $28.50.

The central library of the Nuclear Research Center Juelich offers in its reading room the most important information material about mathematics, physics, chemistry, technology, and the life sciences. The immediately available material comprises 7000 monographs, 3000 journal volumes, and 900 research reports of the KFA. The major groups are subdivided into categories that correspond to special research problems. In addition to the five major groups, smaller sections exist that contain general reference books of the natural sciences as well as for both organization and personnel of science and research in the world. Another small section contains books on legal and economic problems that apply particularly to such installations as the KFA, Juelich. (HBG)

4971 (NIRS–11) ANNUAL REPORT, 1971–1972. (National Inst. of Radiological Sciences, Chiba (Japan)). Oct 1972. 96p. Dep. NTIS (U. S. Sales Only) $7.00.

Brief summaries of research activities during 1971 are presented. Topics covered include monitoring of environmental radioactivity, radiation protection, biology, genetics, chemistry, physics, the use of short-lived radioisotopes in medical diagnostic studies, and preliminary studies on the use of high energy particles for cancer therapy. (CH)

Mathematics and Computers

Refer also to abstracts 4958 and 4959.

4972 (AECL–4311) FORSIM: A FORTRAN ORIENTED SIMULATION PACKAGE FOR THE TRANSIENT SOLUTION OF SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS. Carver, M. B. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Feb 1973. 49p. Dep. NTIS (U. S. Sales Only) $4.50. AECL $1.50.

The FORSIM program is a versatile general system for the solution of sets of ordinary differential equations. The equations, initial conditions, and any special instructions are supplied by the user in a FORTRAN subroutine. This is then loaded with the control routines which perform the integration and any necessary input or output. Although the control routines will complete the solution automatically without any special instructions, the user may intimately control the solution if he wishes. This report, which contains a full description of the latest version of the program, instructions for its use, and several illustrative examples,

is intended to serve as a user's manual and supersedes the previous manual, AECL-3902. (auth)

4973 (AECL-4433) EPOC: SUCCESS I ENGINEERING PACKAGE EXECUTIVE PROGRAM. Erickson, P. D. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 19p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

The EPOC executive program developed for the SUCCESS I Engineering Package is described. The executive is capable of supervising the operation of real-time data acquisition systems by controlling the execution of application programs, written for specific experimental setups. The application packages themselves are composed of a number of "tasks" intended to run asynchronously in response to demands generated either by hardware interrupt signals or by program. The programs are designed to operate in a core-resident system on a PDP-8 computer with a minimum of 8K of core memory. (auth)

4974 (AERE-R-6354) CALCULATION OF FEASIBLE POINTS FOR LINEARLY CONSTRAINED OPTIMIZATION PROBLEMS. Fletcher, R. (Atomic Energy Research Establishment, Harwell (England)). Apr 1970. 20p. Dep. NTIS (U. S. Sales Only) $3.00. UK.

A simple algorithm is described for calculating a feasible vertex so as to provide initial approximations for optimization problems subject to linear constraints. The method does not use ideas of adding artificial variables, and so is convenient when a linear programming package is not available. Problems in which both inequality and equality constraints occur can be tackled, and simplification is made for upper and lower bounds on the variables. It is also possible to inject additional information to accelerate convergence. A proof of convergence is given and a FORTRAN subroutine is provided. (auth)

4975 (AERE-R-6432) PAPERS ON REAL-TIME PROGRAMMING. Pyle, I. C. (ed.). (Atomic Energy Research Establishment, Harwell (England)). Jul 1970. 40p. (CONF-700678-). Dep. NTIS (U. S. Sales Only) $4.00. UK.

The papers were written for discussion at a symposium on Real-Time Programming Languages held at Harwell June 4, 1970. The symposium brought together views from a variety of activities within the Research Group of the Atomic Energy Authority (Harwell and Culham), including system programming for main-site computers, design and programming of on-line computer systems, design of hardware for real-time computer systems and diversification work. (MOW)

4976 (ANCR-1099) NRTS OS/360 CALCOMP PLOT WRITER. Richardson, L. C.; Smith, A. J. (Aerojet Nuclear Co., Idaho Falls, Idaho). Mar 1973. Contract AT(10-1)-1375. 55p. Dep. NTIS $5.45.

This manual describes the special 360/75 CALCOMP Plot Writer developed for processing plotter data on the National Reactor Testing Station (NRTS) 360/75 computer. The writer takes plot data from the IBM System/360 SYSOUT queues, expands them and passes them directly to an online CALCOMP incremental plotter. Information on the capabilities and uses, the operating environment, and an internal description are included for the user and system programmer maintaining the operating system. The plot writer developed has significant improvements over the standard IBM Operating System (OS) writer used to process plotter data. (auth)

4977 (COO-1469-218) QUARTERLY TECHNICAL PROGRESS REPORT, OCTOBER-DECEMBER 1972. Poppelbaum, W. J. (Illinois Univ., Urbana. Dept. of Computer Science). 1972. 137p. (COO-2118-44; UIUCDCS-QPR-72-4). Dep. NTIS $9.00.

Progress on circuit, hardware, software, image processing and pattern recognition, theory, and design research is reported. (LMT)

4978 (COO-1469-220) EFFECT OF VARIABLE MESH SIZE ON THE STABILITY OF MULTISTEP METHODS. Gear, C. W. (Illinois Univ., Urbana. Dept. of Computer Science). Apr 1973. Contract AT(11-1)-1469. 36p. (UIUCDCS-R-73-570). Dep. NTIS $4.00.

The effects of two different techniques for implementing variable mesh sizes in multistep formulas are investigated. It is proved that one is more stable than the other for some cases, but that both are stable when the step changes are small. The practical implications of these results are discussed. (auth)

4979 (COO-1469-221) STABILITY AND CONVERGENCE OF VARIABLE-ORDER MULTISTEP METHODS. Gear, C. W.; Watanabe, D. S. (Illinois Univ., Urbana. Dept. of Computer Science). May 1973. Contract AT(11-1)-1469. 30p. (UIUCDCS-R-73-571). Dep. NTIS $3.50.

The variable step Adam's method is shown to be stable for any order changing scheme. The Nordsieck form of Adam's method, however, is shown to be stable only if the step size and order are fixed for p steps following a change to an r-step method, where p is r or r + 1 depending on the algorithm used to interpolate the necessary higher derivatives. Finally, general consistent and strongly stable multistep and multivalue methods are shown to be stable if the method is fixed for a certain number of steps following each method change and step size changes are small. This number is independent of the differential equation and the step sizes. (auth)

4980 (COO-1469-222) RECORD OF ACHIEVEMENTS AND PLANS OF THE INFORMATION ENGINEERING LABORATORY. Poppelbaum, W. J. (Illinois Univ., Urbana. Dept. of Computer Science). Mar 1973. Contract AT(11-1)-1469. 24p. (UIUCDCS-R-73-568). Dep. NTIS $3.25.

This report describes the work done in the Hardware Research Group in the Department of Computer Science of the University of Illinois in the period 1963 to 1973. The areas covered are: on-line video processing, stochastic computing, electro-optics, pattern recognition, and display devices. Photographs of the most important projects are included. (auth)

4981 (EUR-4940) CADI: A COMPUTER CODE FOR SYSTEM AVAILABILITY AND RELIABILITY EVALUATION. Colombo, A. G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25. EUR B.Fr. 60.-.

A code is described for evaluating the system availability and therefore, as a particular case, for evaluating the system reliability, of systems having elements for which a binary state is assumed: functioning or not functioning. The code is oriented towards a fault-tree representation. First of all it finds deterministically the minimal cut sets, then calculates analytically the availability of each primary event. Finally, it evaluates the system availability as a function of the most significant minimal cut sets and of the availability of the primary events appearing in these critical sets. It also supplies a table, oriented towards sensitivity analysis, which is of great interest for the design and control of complex systems. The code is programmed in FORTRAN IV language and has been implemented on an IBM 370/165 computer. To find the cut sets of order 1, 2 and 3 of a system composed of 200 primary events required roughly two minutes of computer time. The determination of the unavailability of the same system, at 10 different mission times, requires about half a minute. This last computation concerns 86 independent primary events with constant failure and restoration rates, and 957 minimal cut sets of order 2. (auth)

4982 (EUR-4959) ALGORITHM FOR NONLINEAR DATA FIT BY THE LEAST SQUARES METHOD. van der Voort, E.; Halleux, J. P. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Apr 1973. 64p. Dep. NTIS (U. S. Sales Only) $5.25. EUR B.Fr. 85.-.

The least squares estimation of the parameters of a nonlinear curve is accomplished by using the Taylor's series of the summed squares of the residues (Φ) and retaining all the components up to the second order term. The advantage of this method over other methods lies in the fact that the Hessian matrix of the function, Φ, is calculated without any approximation. This procedure allows the rapid localization of the optimal parameters using known second-order methods. Moreover, a brief statistical analysis is given that is based on the exact evaluation of the above-mentioned Hessian matrix evaluated at the optimal point in the parameter space. Finally, a complete listing of a computer program together with a workout example and its output is included. (auth)

4983 (KFK-EXT-13/72-4) PROGRAM DESCRIPTION OF THE SIMULATION SYSTEM PLIM. Fleck, G.; Rupp, M.; Nehmer, J.; Friehmelt, R.; Hilse, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Datenverarbeitung in der technik). Jan 1973. 80p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

This report contains a collection of PL/1 programs written for PLIM (PL/1 machine), a simulation system for simulating operating system software, which was developed at the "Institut für Datenverarbeitung in der Technik" for use on the IBM 360/370 configuration at the Nuclear Center, Karlsruhe. (auth)

4984 (LA-5116) LINEAR FUNCTIONS, DIFFERING WEIGHTS, AND NONLINEAR LEAST SQUARES. Moore, R. H. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 11p. Dep. NTIS $3.00.

A demonstration is given of the equivalence of a number of specialized approaches to the problem of "fitting" linear combinations of variables when the experimental values have differing degrees of quality. It is shown that special algorithms are not required because the problem can be reduced to one that is solved by making use of the concepts of nonlinear least squares. (auth)

4985 (RISO-M-1574) SEMIAUTOMATIC SET-UP AND TESTING OF DIODE FUNCTION GENERATORS IN THE HYBRID COMPUTER EAI 680-PDP8/I,FPP12. Hoekberg, K. S. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

This report is intended as a users manual in connection with the introduction of arbitrary functions of the type y = f(x) into analog or hybrid computation. The diode function generator involved has high computation speed but complicated manual setup as compared with a digital computer used as a function generator. One program, DFGIN, is used for the read-in and testing of the original table of x,y data to be stored on magnetic tape. A second program, DFGSET, is used for the "interactive" setting of a function generator, which approximates the function given with ten straight line segments. Instructions to the generator as to address selection and switch settings are read out on an oscilloscope display. The potentiometers are set on the basis of a tone signal with low frequency for low setting and high frequency for high setting. The third program, DFGTST, is used for fast on-line testing of a function set up on a function generator.

4986 (SCL-DR-720019) RIBSTEAK: A COMPUTER PROGRAM FOR CALCULATING THE DYNAMIC MOTION OF CYLINDRICAL AND CONICAL SHELLS. Emery, A. F.; Cupps, F. J. (Sandia Labs., Livermore, Calif.). Apr 1973. Contract AT(29-1)-789. 123p. Dep. NTIS $8.25.

RIBSTEAK is a general Lagrangian code used to simulate the three-dimensional motion of moderately thick cylindrical and conical shells subjected to impulsive loads. This report describes the construction of the code, which is capable of considering transverse shear, rotatory inertia, plastic work hardening, and large deflections. Examples are given to illustrate these effects. (auth)

4987 (SCL-DR-720361) SUPPLEMENT TO SHOCK CODE REPORT SCL-DR-69-98. Gabrielson, V. K. (Sandia Labs., Livermore, Calif.). Jan 1973. Contract AT(29-1)-789. 21p. Dep. NTIS $3.25.

This memo describes the corrections and additions implemented in the SHOCK code during 1970-71, and should be used as a supplement to the SHOCK code report, SCL-DR-69-98. An addendum to this memo is a review of the various nonlinear options available in the SHOCK code for AXIAL type problems. It denotes inputs and typical responses which may prove valuable in modeling nonlinear systems. Two new routines have been added; one which permits a mass to have its acceleration, velocity, and displacement defined explicitly; the other is a complete rewriting of the FRICTION subroutine. (auth)

4988 (SLA-73-127) DYNAPLAS: A FINITE ELEMENT PROGRAM FOR THE DYNAMIC, LARGE DEFLECTION, ELASTIC-PLASTIC ANALYSIS OF STIFFENED SHELLS OF REVOLUTION. Haisler, W. E.; Stricklin, J. A.; Von Riesemann, W. A. (Texas Agricultural and Mechanical Univ., College Station. Dept. of Aerospace Engineering). 1 Dec 1972. Contract 82-6868. 160p. (TEES-72-27). Dep. NTIS $3.00.

A user's guide for the DYNAPLAS computer code (DYNAmic, Large Deflection, Elastic-PLAStic analysis of Stiffened Shells of Revolution) is presented. The finite element method of analysis is utilized for the analysis with the Houbolt numerical integration scheme being used to solve the equations of motion. The DYNAPLAS code accepts as input a tape containing the structural stiffness and mass properties generated by the SAMMOR III code. Documentation of the analysis technique is presented along with user guidelines and a discussion of the program limitations. Instructions for preparing the input data are given along with several example problems which demonstrate the required input data. Results of several example problems are presented to aid the user in check-out and comparison purposes. An appendix is included which provides the interested user with flow charts, variable names, subroutine functions, etc. (auth)

4989 (SLL-73-5201) PERFORMANCE AND METHODOLOGY OF A DIGITAL RANDOM VIBRATION CONTROL SYSTEM. Nelson, D. B. (Sandia Labs., Livermore, Calif.). [nd]. 7p. (CONF-730401-4). Dep. NTIS $3.00.

From 19th annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973).

Control accuracy of better than ±0.75 db over 2000-Hz bandwidths was achieved with exciter-specimen load combinations that require up to 60 db of dynamic range. Controller setup time was reduced to a matter of a minute or two with essentially no manual adjustment. Hardcopy results in the form of an X-Y plot or CRT photograph of the control point and/or exciter drive signal power spectral densities confirm equalization quality during or immediately following each test. The system hardware, system operation, control system analysis, control policy, drive signal generation, and system performance are described. (MOW)

4990 (TP-422) FORTRAN SUBROUTINES FOR THE SOLUTION OF LAPLACE'S EQUATION OVER A GENERAL REGION IN TWO DIMENSIONS. Reid, J. K.; Turner, A. B. (Atomic Energy Research Establishment, Harwell (England)). Sep 1970. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

One of the authors (Reid) has proposed an automatic means of constructing finite-element approximations that ensures that the triangular elements have internal angles that are never very small and have sides that cannot be pathologically small or pathologically large; the algorithm also ensures that the matrix of the system is monotone (following Collatz, it is said that a matrix is monotone if it is nonsingular and all elements of its inverse are non-negative). Fortran subroutines are presented to implement the procedure and report on some numerical experience obtained in their use. (auth)

4991 (TT-72-50009) COMPUTER ELEMENTS AND SYSTEMS. Collection of Papers, Issues Nos. 38-40, 1970. Translation of Vychisl. Sist.; No. 38-40, (1970). 332p. (IPST-Cat.-60103-4; IPST-Cat.-60105-6; IPST-Cat.-60106-2). NTIS $18.75.

4992 (UCID-30056) SPECIFICATIONS OF A FORTRAN CALLABLE GRAPHICS SUBROUTINE PACKAGE (GRAFPAC). River, M.; Storch, N. (California Univ., Livermore. Lawrence Livermore Lab.). 26 Jan 1973. Contract W-7405-eng-48. 42p. Dep. NTIS $4.25.

GRAFPAC is a new graphics package, device- and host-computer independent for wide usage by FORTRAN programmers at LLL. Currently there are a number of FORTRAN graphics device packages available to the user. Each limits output to one or at most two devices, and is unlike the others. (MOW)

4993 (WAPD-TM-1079) MESH 3D: A THREE-DIMENSIONAL FINITE ELEMENT MESH GENERATOR PROGRAM FOR EIGHT-NODE ISOPARAMETRIC ELEMENTS. Hutula, D. N.; Zeiler, S. M. (Bettis Atomic Power Lab., Pittsburgh, PA). Mar 1973. Contract AT(11-1)-Gen-14. 103p. Dep. NTIS $7.25.

MESH3D is a digital computer program for automatic generation of three-dimensional finite element meshes composed of eight-node isoparametric elements. The program, written in FORTRAN IV for the CDC-6600 and CDC-7600 computers, is specifically designed for use with the APACHE thermal analysis and MATUS structural analysis finite-element computer programs. MESH3D constructs a mesh by assembling a number of user-defined curved blocks, each of which is automatically subdivided into finite elements. The graphical output capabilities of MESH3D include plots of isometric views of the mesh and plots of the intersection of the mesh with an arbitrary plane. (auth)

4994 (WAPD-TM-1081) MATUS: A THREE-DIMENSIONAL FINITE-ELEMENT PROGRAM FOR SMALL-STRAIN ELASTIC ANALYSIS. Hutula, D. N.; Wiancko, B. E. (Bettis Atomic Power Lab., Pittsburgh, PA). Mar 1973. Contract AT-11-1-GEN-14. 194p. Dep. NTIS $11.75.

MATUS is a three-dimensional finite element computer program for small-strain elastic analysis of structures subjected to mechanical and thermal loads. An eight-node tri-linear isoparametric element is used. The program is written in FORTRAN IV and COMPASS Assembly Language for the CDC-6600 and CDC-7600 computers. Problems with up to about 3200 nodes can be solved on a 60-bit wordlength computer with a central memory size of 64K and an extended core size of 512K (K = 1024). The APACHE thermal analysis program can be used to generate temperature distributions for use in MATUS. The MESH3D mesh generator program can be used to generate finite element meshes for MATUS and APACHE. (auth)

4995 (Y-1870) MACHINE TOOL CONTROL VIA A MINICOMPUTER. Bowers, G. L. (Oak Ridge Y-12 Plant, Tenn. (USA)). 18 Apr 1973. Contract W-7405-eng-26. 73p. Dep. NTIS $5.45.

A minicomputer control system was developed for a two-axis machine tool lathe. One of the principal objectives of this project was to drive the axes' motors via open-loop control with a posi-

tioning resolution of 25 microinches. Two methods for driving the axes' motors were developed. Initially, a combination hardware-software method was used for generating command pulses. Aluminum hemishells and tensile specimens were machined to specifications with this control technique. However, a rapid, traverse speed limitation due to the software addition time of the hardware-software adder was discovered. In order to increase the maximum slide velocity, a pure hardware adder was developed. The maximum rapid traverse rate was increased to 15 inches per minute (ipm). Both techniques offer equivalent machining quality. By eliminating the software addition required by the hardware-software adder technique, the amount of computer time consumed in the control process is greatly reduced. As a result of the increase in duty-free computer time, a multimachine control system seems to be very feasible. (auth)

Miscellaneous

4996 (AERE-R-6987) LEAD IN HUMAN TISSUE: A LITERATURE SURVEY WITH PARTICULAR REFERENCE TO THE DETERMINATION OF LEAD IN HUMAN RIB. Hislop, J. S.; Parker, A. (Atomic Energy Research Establishment, Harwell (England)). Dec 1971. 24p. Dep. NTIS (U. S. Sales Only) $3.25. UK 50 pence.

4997 (BDX-613-713(Rev.)) SURFACE ENERGETICS OF CONFORMAL COATING LEVELING. Jackson, L. C. (Bendix Corp., Kansas City, Mo.). Apr 1973. Contract AT(29-1)-613. 21p. Dep. NTIS $3.25.

The technology of surface energies has been used to solve a portion of leveling a conformal coating on small-diameter wires. The derivation made use of solubility parameters (polar and dispersion forces), surface tension studies, and principles of adhesion and cohesion to demonstrate that polarity of the coating contributed to a beading effect on the wires. Electrical tests at high voltages and vacuum established that a 4% nonane solvent added to the conformal coating greatly improved its application. Isodensitracer analysis was made to graphically show the improvement factor. The type of work needed to further improve the application is given. (auth)

4998 (BDX-613-805) GOLD PLATING. Final Report. Stimetz, C. J. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 17p. Dep. NTIS $3.00.

The purity and microhardness of gold deposits from nine different gold plating solutions were determined. In general, these solutions gave soft high-purity gold deposits. A study was conducted on these solutions to determine the effects of metallic contamination on the purity and microhardness of the gold deposits. (auth)

4999 (BDX-613-870) EFFECT OF AMINE CATALYST ON COMPRESSIVE PROPERTIES OF URETHANE FOAM. DeGisi, S. L.; Neet, T. E. (Bendix Corp., Kansas City, Mo.). Mar 1973. Contract AT(29-1)-613. 23p. Dep. NTIS $4.00.

Experiments were performed to determine if compressive properties of a rigid urethane foam system were independent of an amine catalyst used in the material formulations. Compression testing confirmed that neither type or concentration of amine catalyst significantly affected the physical properties of equivalent density foams provided they were adequately cured. (auth)

5000 (BMI-171-121) PESTICIDE RESIDUES IN BIRDS FROM AMCHITKA ISLAND. Amchitka Bioenvironmental Program. Bell, D. E. (Battelle Memorial Inst., Columbus, Ohio). 8 May 1969. Contract AT(26-1)-171. 7p. Dep. NTIS $3.00.

5001 (BNL-17775) ECOLOGICAL EFFECTS OF GROWTH. Woodwell, G. M. (Brookhaven National Lab., Upton, N. Y.). 3 Apr 1973. 26p. Dep. NTIS $3.50.

5002 (BNL-17784) EFFECT OF CALCITONIN ON CALCIUM METABOLISM IN THE RAT. Dombrowski, C. S.; Shukla, K. K.; Cohn, S. H. (Brookhaven National Lab., Upton, N. Y.). 1972. 68p. Dep. NTIS $5.50.

5003 (BNL-50371) COMPOSITE MATERIALS FOR RAILROAD APPLICATIONS. A Feasibility Study for Renovating Deteriorated Wooden Railroad Crossties. Beller, M.; Steinberg, M. (Brookhaven National Lab., Upton, NY). Feb 1973. 29p. Dep. NTIS $3.50.

5004 (BNL-tr-529) SCATTERING OF LIGHT NEAR THE SECOND-ORDER PHASE-TRANSITION POINTS. Ginzburg, V. L. Translated by S. J. Amoretty from Dokl. Akad. Nauk SSSR; 105: No. 2, 240-243(1955). 8p. Dep. NTIS $3.00.

Scattering of light in substances situated near the second-order phase transition point (Curie point) exhibits certain peculiarities that are pointed out. (JCW)

5005 (CEA-CONF-2101) CONTRIBUTION TO THE STUDY OF HEALTH PROBLEMS POSED BY LEAD. Teaching of Industrial Hygiene and of Environmental Control. Chalabreysse, J.; Archimbaud, M.; Teulon, F.; Simeon, C. (Commissariat a l'Energie Atomique, Pierrelatte (France)). 15 Jul 1972. 17p. (In French). Dep. NTIS (U. S. Sales Only).

5006 (CEA-CONF-2119) CONTRIBUTION TO THE STUDY OF THE STABILITY OF COLD-WORKED AUSTENITIC STEELS, PARTICULARLY DURING CREEP TESTS: INFLUENCE OF CARBON-STABILIZING ELEMENTS. Calvert, J.-N.; Petrequin, P.; Weisz, M.; Badard, A. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 47p. (In French). (CONF-721063-5). Dep. NTIS (U. S. Sales Only).

From autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

5007 (CEA-CONF-2193) HYDROGEN ADSORPTION ON Ni(100). Lapujoulade, J.; Neil, K. S. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 10 Jul 1972. 25p. (CONF-720679-1). Dep. NTIS (U. S. Sales Only) $3.25.

From second symposium on surface physics: the solid vacuum interface; Enschede, Netherlands (22 Jun 1972).

The adsorption of hydrogen on the (100) plane of nickel at room temperature was investigated, using the technique of flash desorption spectroscopy. It is shown that no variation in the adsorption enthalpy of 23.1 kcal/mole occurs during the chemical cleaning of the surface by repeated oxidation and reduction. The number of adsorption sites does, however, increase to 3.3 $10^{14}/cm^2$ during this process. (JCW)

5008 (CEA-CONF-2221) RELIABILITY AND MAINTAINABILITY: TWO IMPORTANT CHARACTERISTICS FOR THE TECHNICAL SUPPORT SERVICES. Guyot, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 24 Nov 1972. 15p. (CONF-730120-1). Dep. NTIS (U. S. Sales Only) $3.00.

From conference on reliability and maintainability; Paris, France (23 Jan 1973).

5009 (CGS-746-106) ALEUTIAN SEISMIC PROGRAM. Seismological Bulletin, April 1970. (National Ocean Survey, Rockville, MD). Feb 1971. Contract AT(29-2)-746. 49p. Dep. NTIS $4.50.

5010 (CGS-746-107) ALEUTIAN SEISMIC PROGRAM. Seismological Bulletin, May 1970. (National Ocean Survey, Rockville, MD). Feb 1971. Contract AT(29-2)-746. 81p. Dep. NTIS $6.25.

5011 (CGS-746-113) ALEUTIAN SEISMIC PROGRAM. Seismological Bulletin, November 1970. (National Ocean Survey, Rockville, MD). Jun 1971. Contract AT(29-2)-746. 70p. Dep. NTIS $5.50.

5012 (CGS-C-119) PRELIMINARY CALIBRATION OF THE SCATT-1 SYSTEM. (Coast and Geodetic Survey, Las Vegas, Nev. Special Projects Party). 16 Feb 1968. 106p. Dep. NTIS $7.50.

This report describes the component parts of the SCATT-1 System with some theory, and the results from the Albuquerque, New Mexico and Garland, Texas (Geotech) shake-table calibrations. A proposed field calibration using the internal test oscillator of the System is given with cognizance of the fact that field experience and analysis may alter the procedure in the future. A complete Precision Instrument Model 400 magnetic tape record-reproducer has been installed at the Las Vegas C&GS Laboratory. This new reproducer is primarily for compiling, compacting or expanding the data obtained from the SCATT-1 Systems. (auth)

5013 (COO-1082-39) STUDIES OF ION EXCHANGE MEMBRANES AND FLOWTHROUGH ELECTRODES APPLIED TO CONTINUOUS ANALYSIS. Final Report. Blaedel, W. J. (Wisconsin Univ., Madison. Dept. of Chemistry). 15 Apr 1973. Contract AT(11-1)-1082. 6p. Dep. NTIS $3.00.

5014 (COO-1602-35) MODULATION OF RABBIT TESTICULAR CONTRACTIONS BY PROSTAGLANDINS, STEROIDS, AND SOME PHARMACOLOGICAL COMPOUNDS. Seeley, R. R.; Hargrove, J. L.; Johnson, J. M.; Ellis, L. C. (Utah State Univ., Logan. Dept. of Zoology). 26 Jun 1972. Contract AT(11-1)-1602. 8p. Dep. NTIS $3.00.

5015 (COO-1791-4) THERMODYNAMIC PROPERTIES OF SOLID ALLOYS OF CHROMIUM WITH NICKEL AND IRON. Final Report. Mazandarany, F. N.; Pehlke, R. D. (Michigan Univ., Ann Arbor). 1972. Contract AT(11-1)-1791. 45p. Dep. NTIS $4.25.

The thermodynamic properties of chromium were determined in the Ni–Cr and Fe–Cr binary systems and in the Fe corner of the Fe–Ni–Cr system. These properties are based on experimental measurements using solid oxide electrolyte cells of the type: Cr, $Cr_2O_3|ThO_2-Y_2O_3|Cr$ (alloy), Cr_2O_3. (JCW)

5016 (COO-3027-6) POOL BOILING AND CONDENSATION OF ELEMENTAL SELENIUM. Breitstein, L.; Bonilla, C. F. (Columbia Univ., New York. Liquid Metals Research Lab.). 1971. Contract AT(11-1)-3027. 173p. Dep. NTIS $10.75.

5017 (COO-3115-6) GENETICAL AND DEVELOPMENTAL STUDY OF A COMPLEX LOCUS IN THE HOUSE MOUSE. Technical Progress Report. Dunn, L. C.; Bennett, D. (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Biological Station). 1972. Contract AT(11-1)-3115. 4p. Dep. NTIS $3.00.

5018 (COO-3158-15) MODIFIED GREEN'S FUNCTION TECHNIQUE FOR THE CALCULATION OF LATTICE DISTORTION SURROUNDING INTERSTITIALS. Benedek, R.; Ho, P. S. (Cornell Univ., Ithaca, N. Y. Dept. of Materials Science and Engineering). 23 Jan 1973. Contract AT(11-1)-3158. 28p. Dep. NTIS $3.50.

The Green's function technique for the calculation of lattice distortion surrounding point defects is modified to enable the treatment of interstitial defects. The modification consists in treating a selected region immediately surrounding the interstitial formally as a cluster of n + 1 interstitials and n vacancies. This region, called the interstitial "core", includes atoms displaced by large amounts from their normal lattice sites and, therefore, cannot be treated within the standard harmonic approximation. The method is illustrated by a calculation for the [111] split crowdion configuration in tungsten. Displacement fields are calculated for two separate interatomic potentials, one fitted to the phonon spectrum and the other to elastic constants. Predicted atomic relaxations for both potentials are quite similar. (auth)

5019 (COO-3156-55) ENERGY ANALYSIS OF SMALL-ANGLE DIFFRACTION PATTERNS IN ALUMINUM FILMS. Pettit, R. B.; Silcox, J.; Vincent, R. (Cornell Univ., Ithaca, N. Y. Dept. of Applied Physics). [nd]. 2p. (CONF-710833-2). Dep. NTIS $3.00.

From 29th annual meeting of the Electron Microscopy Society of America; Boston, Massachusetts, USA (9 Aug 1971).

5020 (COO-3222-3) OPERATIONS ORDER: R/V ATLANTIC TWIN, DECEMBER 12–14, 1972. (Columbia Univ., Palisades, N. Y. Lamont-Doherty Geological Observatory). 1972. AT(30-1)-3222. 5p. Dep. NTIS $3.00.

5021 (CSIRO-Trans-11258) LIMNOLOGICAL DYNAMICS: A STUDY OF THE DYNAMICS OF LAKE GENEVA USING TRITIUM. Hubert, P.; Meybeck, M.; Olive, P. Translated by D. R. Eddy from Compt. Rend., Ser. D; 270: 1298-1301(1970). 3p. Dep. NTIS (U. S. Sales Only) $3.00.

5022 (EDFB-IBP-73-2) ORGANIC MATTER BUDGET AND MODEL FOR A SOUTHERN APPALACHIAN LIRIODENDRON FOREST. Sollins, P.; Reichle, D. E.; Olson, J. S. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 150p. Dep. NTIS $3.00.

Thesis. Submitted by P. Sollins to Univ. of Tennessee, Knoxville.

5023 (EUR-4864) IODINE METABOLISM IN CHILDREN AND ADOLESCENTS IN A REGION OF THE EEC. Karhausen, L.; Pages, J. P.; Vacca, G.; Piepz, A.; de Visscher, M. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). Mar 1973. 128p. (In French). Dep. NTIS (U. S. Sales Only) $8.50. EUR FB 165,-.

5024 (IA-1272) VIBRONIC LEVELS IN F-CENTRE EXCITED STATES. Englman, R. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Oct 1972. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

A Hamiltonian is given for the 2s and 2p states of F centers, including vibronic coupling with τ_{1u}-type modes in the first and second order. Computed energy levels are plotted for some low-lying states as a function of the linear coupling strength for zero or weak quadratic coupling. The reduction factors $K(E_g)$ and $K(T_{2g})$ are greater or less than 0.2, depending on whether 2s is above or below 2p. (auth)

5025 (INP-814) MOESSBAUER ABSORPTION IN CALCIUM–IRON OLIVINES. Hrynkiewicz, A. Z.; Kulgawczuk, D. S.; Mazanek, E. S.; Wlasak, J.; Wyderko, M. E. (Institute of Nuclear Physics, Krakow (Poland)). Nov 1972. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Moessbauer absorption measurements for a series of calcium–iron olivines of the type $(Fe_{1-x}Ca_x)_2SiO_4$ with $0 \leq x \leq 0.65$ were performed at room temperature and at 500 K. The observed jump of the quadrupole splitting near x = 0.40 is attributed to a change of the crystalline field. (tr-auth)

5026 (INR-1424) METASTABLE INTERMEDIATE PHASE IN THE Sb–Ge SYSTEM. Chyczewski, M.; Matyja, H. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 24p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.25.

The results of investigation of the influence of rapid cooling from the liquid state (at the rates of the order of 10^6 to 10^8 °C/sec) on the structure of Sb–Ge alloys are presented. Increases of solubility of Ge in Sb (up to ~20 at. %) and Sb in Ge (up to 10 at. %) have been found in this system. The metastable phase occurred with very likely the rhombohedral structure of the deformed NaCl type. Based on the time of decomposition of the phase the activation energy of decomposition was determined to be ~24.9 kcal/mol. (tr-auth)

5027 (INR-1426) METASTABLE INTERMEDIATE PHASES IN THE Sb WITH Cr, Fe, Ni, AND IN THE Te WITH Co, Fe, Ni SYSTEMS. Chyczewski, M.; Calka, A.; Matyja, H. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 30p. (In Polish). Dep. NTIS (U. S. Sales Only) $3.50.

As a result of rapid quenching from the liquid state the intermediate metastable phases of the $Po(\alpha)$ (A_h) type have been obtained in the Sb–Cr, Sb–Fe, and Sb–Ni alloys. Based on the decay time of the diffraction peaks the activation energies of decomposition of those phases were calculated. The Fe and Ni solubility in Sb has been observed. The metastable intermediate phases in Te–Co, Te–Fe, and Te–Ni were observed. (tr-auth)

5028 (INS-J-137) NICKEL: INDICATOR OF EXTRATERRESTRIAL MATTER ACCRETION ON THE EARTH. Ohtsuka, H.; Tazawa, Y.; Yamakoshi, K.; Yasuda, S. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 27 Nov 1972. 9p. Dep. NTIS (U. S. Sales Only).

5029 (ITF-72-88-P) PECULIARITIES OF PHONON DISPERSION IN CRYSTAL WITH SUBSTITUTIONAL IMPURITIES. Dzyub, I. P.; Kochmarskii, V. Z. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 88p. (In Russian). Dep. NTIS (U. S. Sales Only) $6.50.

A group-theoretical and numerical analysis of peculiarities of the phonon dispersion in crystals with small concentration of substitutional impurities was carried out in the case of simple cubic lattice, with the force-constant change taken into account. It is shown that, in the frequency region of quasi-local vibration due to effective damping associated with resonance-phonon scattering by impurities, the dispersion curves defined by spectral density maxima of the correlation function of substitutional atoms suffer from discontinuity. Discontinuity of dispersion curves display a one-phonon peak splitting at the slow-neutron coherent scattering. (JCW)

5030 (ITF-72-94-P) MAGNON SIDE-BANDS THEORY OF EXCITON TRANSITIONS IN ANTIFERRODIELECTRICS. Petrov, E. G. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 46p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.50.

One-, two-, and three-magnon sidebands of exciton transitions in antiferrodielectrics are considered when the available spins are noncollinear. The effective dipole moments of transitions are obtained in order to investigate the magnon sidebands. The role of the exciton–magnon interactions on the magnon sidebands maxima positions is examined. It is shown that maxima position is not defined by a sum of maximal magnon frequency on the Brillouin band boundary. The formulas for the integral intensities of light absorption by magnon sidebands are listed as well as the formulas for the intensity maxima positions. It is shown that light absorption by magnon sidebands is defined only in terms of the two parameters that can be obtained independently from the consideration of one-particle light absorption. (tr-auth)

5031 (ITF-72-112-P) DISPERSION OF LIGHT IN THE RANGE OF ABSORPTION BY IMPURITY CENTERS. II. Oleksin, D. I.; Fishuk, I. I.; Nguen Khac Nyap (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

Results obtained in investigating the shape of light dispersion curves in the range of impurity absorption in a solid-state body are given; a weak anharmonism of nuclear vibrations and the changes in quasi-elastic constants in phototransitions were taken into account. An expression for the shape of absorption curves is obtained and discussed. (tr-auth)

5032 (ITF-72-116) RIGID-BODY DYNAMICS IN SPECIAL RELATIVITY. Evtushenko, S. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Rigid-body dynamics is considered on the basis of the kinematic equations of motion of a Born rigid body derived earlier within special relativity. The presence of a parameter common for all points of the body is essential. This made it possible to derive an expression for the sum force and sum moment of forces acting on a rigid body. (tr-auth)

5033 (ISSP-A-574) EFFECT OF SPIN FLUCTUATIONS ON ITINERANT ELECTRON FERROMAGNETISM. II. Moriya, T.; Kawabata, A. (Tokyo Univ. (Japan). Inst. for Solid State Physics). Feb 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

5034 (JINR-P2-6937) INVESTIGATION OF NONRELATIVISTIC PARTICLE INTERACTION WITH QUANTIZED SCALAR FIELD BY FUNCTIONAL INTEGRATION METHOD. Kuleshov, S. P.; Matveev, V. A.; Sisakyan, A. N.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. (In Russian). (CONF-721219-1). Dep. NTIS (U. S. Sales Only) $3.50.

From international conference on mathematical problems of quantum field theory and quantum statistics; Moscow (12 Dec 1972).

5035 (JINR-P2-6957) BUST MATRIX ELEMENTS FOR REDUCTION O(3,1) CONTAINS O(2,1) CONTAINS O(2). Smorodinskii, Ya. A.; Shepelev, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

5036 (JINR-P2-7002) TRACES OF REPRESENTATIONS OF A GROUP OF GENERALIZED SHEARS OF THE FIVE-DIMENSIONAL HYPERBOLOID. Lebedenko, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 11p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

5037 (JINR-P4-6998) ESTIMATE OF THERMODYNAMIC FUNCTIONS OF A FERROMAGNET WITH THE INTERACTION J/N. Brankov, I. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Mathematically rigorous estimates are found for the closeness of free energy, entropy, and internal-energy densities of a ferromagnetic model with the interaction J/N to the corresponding thermodynamic functions in molecular-field theory. (auth)

5038 (JINR-P4-7000) MAGNETIZATION AND MAGNETIC SUSCEPTIBILITY OF AN ISING MODEL WITH THE INTERACTION J/N. Brankov, I. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Mathematically rigorous estimates are found for the closeness of magnetization and magnetic susceptibility per spin in an N-body Ising model with the interaction J/N to the corresponding functions in the molecular-field theory. (tr-auth)

5039 (JINR-P11-6933) METHODS OF INVERSION OF QUASITRIDIAGONAL AND BANDMATRICES. Emel'yanenko, G. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

5040 (JUL-917-RA) MOLECULAR BIOLOGICAL INVESTIGATIONS OF NUCLEIC ACID EXCHANGE IN THE CHICKEN EMBRYO AND ITS INTERFERENCE BY DDT. Groneuer, K. J. (Kernforschungsanlage, Juelich (West Germany)). Jan 1973. 128p. (In German). Dep. NTIS (U. S. Sales Only) $8.50.

5041 (KFK-1753) CREEP BEHAVIOR OF POLYCRYSTALLINE ALUMINUM OXIDE AND Al_2O_3/Cr CERMETS. Engelhardt, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jan 1973. 148p. (In German). Dep. NTIS (U. S. Sales Only) $9.50.

5042 (LA-5154-MS) ELECTRON TRANSPORT IN GAS DISCHARGE LASERS. Henderson, D. B. (Los Alamos Scientific Lab., N. Mex.). Apr 1973. Contract W-7405-eng-36. 10p. Dep. NTIS $3.00.

5043 (LBL-1404) CHEMICAL TRANSPORT REACTION ANALYSIS FOR CRYSTAL GROWTH OF BINARY AND TERNARY CHALCOGENIDES. Agnihotri, R. B. (California Univ., Berkeley. Lawrence Berkeley Lab.). Dec 1972. Contract W-7405-eng-48. 137p. Dep. NTIS $9.00.

Thesis.

The chemical transport crystal growth of binary and ternary chalcogenides in a closed container using halogens as transport agents is analyzed for diffusion-controlled kinetics in terms of thermodynamics of gas–solid equilibria, temperature conditions, and initial transport agent concentration. (JCW)

5044 (LFEN-NI-75-a) FORTRAN SUBPROGRAMS FOR THE DETERMINATION OF SEVERAL PHYSICAL PROPERTIES OF WATER AND OF AIR. Mota, J.; Brazao, J. (Junta de Energia Nuclear, Sacavem (Portugal). Laboratorio de Fisica e Engenharia Nucleares). 1972. 46p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $4.50.

5045 (NIM-961) PREPARATION OF STANDARD SOLUTIONS FOR THE PLATINUM-GROUP METALS AND GOLD. Laboratory Preparation Method No. 6. Robert, R.; Steele, T. W. (National Inst. for Metallurgy, Johannesburg (South Africa)). 12 May 1970. 4p. Dep. NTIS (U. S. Sales Only) $3.00.

5046 (NP-19647) REPORT ON THIRD SERIES OF MEETINGS, STANDING COMMITTEE ON CIVIL LIABILITY FOR NUCLEAR DAMAGE, VIENNA, 1–4 JUNE 1971. (International Atomic Energy Agency, Vienna (Austria)). 15 Sep 1972. 20p. (CN-12/SC/20). Dep. NTIS (U. S. Sales Only).

5047 (NP-19714) INFLUENCE OF THE SURFACE IN HEAT TRANSFER AND PRESSURE DROP FOR WIDE TURBULENT CHANNEL FLOW. Kjellstroem, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 1 Feb 1967. 22p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.25.

5048 (NP-19723) SYSTEMATIC APPROACH TO CONSTRAINED SELF-CONSISTENT-FIELD THEORY, WITH PARTICULAR EMPHASIS ON THE MOLECULAR-ORBITAL APPROXIMATION. Bjoernaa, N. (Oslo Univ. (Norway). Fysisk Institutt). 1972. 70p.

Thesis.

5049 (NP-19725) NUMERICAL SIMULATION OF TWO-DIMENSIONAL QUASI-STATIONARY ELECTROMAGNETIC FIELDS. Preprint B-0169. Doinikov, N. I. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 23p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

5050 (NRC-TT-1625) NUTRITIVE IMPORTANCE AND STRUCTURE OF DETRITUS. Rodina, A. G. 1972. Translated by V. Poppe from pp 35-42 of Biologicheskie Resursy Vodoemov, Puty ikh Rekonstruktsii i Ispol'zovaniya, Izdatel'stvo Nauka, Moscow, 1966. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

5051 (ORNL-4879) TOBACCO SMOKE RESEARCH PROGRAM PROGRESS REPORT. Guerin, M. R.; Nettesheim, P. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 166p. Dep. NTIS $3.00.

5052 (ORNL-NSF-EP-37) REGIONAL MODELING ABSTRACTS: BIBLIOGRAPHY OF REGIONAL ANALYSIS. Volume IV. Meyers, C. R. Jr. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 391p. (ORNL-EIS-72-53). Dep. NTIS $21.75.

The fourth 1000 abstracts of literature acquired and indexed by the Regional Environmental Systems Analysis (RESA) Team of the Oak Ridge National Laboratory–National Science Foundation Environmental Program are given. The abstracts cover literature on the development and use of mathematical models capable of simulating the economic, demographic, societal, ecological, and land-use responses of a geographical region to alternative policy decisions. Access to the abstracts is achieved through various indexes: key word, author, permuted title word, and permuted key word (or phrase). (auth)

5053 (ORO-2410-24) NITRATE ABSORPTION AND STRONTIUM ACCUMULATION. Annual Progress Report, 1 August 1972–31 July 1973. Jackson, W. A. (North Carolina State Univ., Raleigh. Dept. of Soil Science). Apr 1973. Contract AT(40-1)-24. 43p. Dep. NTIS $4.25.

5054 (ORO-2410-25) NITRATE ABSORPTION AND STRONTIUM ACCUMULATION. Summary Report, 1 May 1971–31 July 1973. Jackson, W. A. (North Carolina State Univ., Raleigh. Dept. of Soil Science). Apr 1973. Contract AT(40-1)-2410. 8p. Dep. NTIS $3.00.

5055 (ORO-3759-5) STUDIES WITH TROPICAL AND SUBTROPICAL MICROALGAE. Progress Report, August 1, 1972–July 31, 1973. Bunt, J. S. (Miami Univ., Fla. Rosenstiel School of Marine and Atmospheric Sciences). 1973. Contract AT(40-1)-3795. 92p. Dep. NTIS $6.75.

5056 (ORO-3935-25) STUDY OF ALLOY STRENGTHENING DUE TO ATOMIC ORDER. Progress Report, May 1, 1972–April 30, 1973. Marcinkowski, M. J. (Maryland Univ., College Park. Dept. of Mechanical Engineering). 1973. Contract AT-(40-1)-3935. 280p. Dep. NTIS.

5057 (ORO-3941-17) MECHANISMS OF RECOMBINATION AND FUNCTION OF DNA IN BACTERIA. Progress Report, May 11, 1972–May 10, 1973. Guild, W. R. (Duke Univ., Durham, N. C.). 1973. Contract AT(40-1)-3941. 8p. Dep. NTIS $3.00.

5058 (RISO-M-1582) STUDY OF MENTAL PROCEDURES IN ELECTRON SHOOTING. Rasmussen, J.; Jensen, A. (Danish Atomic Energy Commission, Risoe. Research Establishment). Feb 1973. 71p. Dep. NTIS (U. S. Sales Only) $5.75.

The mental procedures used by skilled electronics repair men in their normal working environment were studied by analysis of verbalized records. The aim of the experiment was to identify and isolate typical heuristic subroutines used by the repair men, and to have a qualitative description of the typical features of the subroutines and their role in the search procedures. The records demonstrate a great ability in the men to conduct the search by general routines mostly depending upon their general professional background, and a preference for rapid streams of simple decisions as good/bad judgements regardless of whether observations are informationally redundant or not. Seen from the viewpoint of information economy, the procedures are inefficient, but if the men are supposed to minimize the time spent on the task and the mental load involved, the procedures are very rational. (MOW)

5059 (RISO-275) STUDIES ON THE MECHANISM OF FATTY ACID SYNTHESIS IN ANIMALS. The Carboxylation of Acetyl-CoA in the Presence of Fatty Acid Synthetase. Hansen, H. J. M. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1972. 82p. Dep. NTIS (U. S. Sales Only) $6.25.

5060 (RLO-2225-T-26-8) FEEDING PROCESSES AT LOWER TROPHIC LEVELS IN PELAGIC COMMUNITIES. Frost, B. W. (Washington Univ., Seattle. Dept. of Oceanography). 1972. Contract AT(45-1)-2225. 33p. Dep. NTIS $3.75.

5061 (RLO-2227-T-1-8) REACTIONS OF MATRIX-ISOLATED NiF_2 AND $NiCl_2$ with CO, N_2, NO, AND O_2 IN ARGON MATRICES. Van Leirsburg, D. A.; DeKock, C. W. (Oregon State Univ., Corvallis. Dept. of Chemistry). 1972. 23p. Dep. NTIS. $3.25.

The infrared spectra of nickel fluoride and nickel chloride isolated in matrices doped with CO, N_2, NO and O_2 have been observed. Complexes of NiF_2 and $NiCl_2$ with these small molecules are found to form in the matrix and their frequencies have been tabulated. The results indicate that these complexes may be formulated in terms of σ bonding between the small molecule and nickel halide with little or no π backbonding. Evidence for a D_{2h} planar fluoride bridged dimer structure for the nickel fluoride dimer is also given. (auth)

5062 (RT/BIO-(72)76) LIVING STATE PHYSICS. The Piezoelectric Effect as Unifying Hypothesis for Functional and Structural Processes in Biological Membranes: Preliminary Remarks. Caserta, G.; Cervigni, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 21 Dec 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

5063 (SC-DC-72-1494) THERMAL DECOMPOSITION OF ZINC CHROMATES. Clark, R. P.; Reinhardt, F. W. (Sandia Labs., Albuquerque, N. Mex.). 1973. 28p. Dep. NTIS $3.50.

A study of the thermal decomposition in air of zinc chromates from several sources was conducted using thermogravimetry, chemical analysis, emission spectroscopy, and x-ray diffraction analysis. Four zinc chromate samples were obtained from commercial suppliers and four others were prepared in this laboratory. The zinc chromates were identified as various materials depending on the method of preparation. (JCW)

5064 (SC-DR-72-887) SURVEY OF THE PROPERTIES OF CHROMIUM-GOLD METALLIZATION FOR HYBRID MICROCIRCUITS. Long, R. L. Jr. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. 66p. Dep. NTIS $5.50.

5065 (SCL-DR-720035) INFLUENCE OF SULFUR CONTENT ON THE IMPACT STRENGTH OF ELECTROFORMED NICKEL. Dini, J. W.; Johnson, H. R.; Saxton, H. J. (Sandia Labs., Livermore, Calif.). Mar 1973. Contract AT(29-1)-789. 25p. Dep. NTIS $3.25.

The influence of sulfur content on the impact strength of electroformed nickel was determined by modified Charpy and Izod tests. The influence of sulfur on hardness was also evaluated. A modified Izod test specimen was designed and tested for use in certifying a plated-joint configuration. The test serves as an indicator of the notch sensitivity of the plated joint and the adherence of the deposit to the substrate. (auth)

5066 (SCL-DR-720090) HIGH-STRENGTH NICKEL-COBALT DEPOSITS FOR ELECTROJOINING APPLICATIONS. Dini, J. W.; Johnson, H. R.; Helms, J. R. (Sandia Labs., Livermore, Calif.). Mar 1973. Contract AT(29-1)-789. 30p. Dep. NTIS $3.50.

Nickel-cobalt alloy deposits were shown to be suitable for use in high-strength electrojoining applications. Influence of solution operating variables on composition and physical properties are reported. Important contributions to previous work with this system were the observation of the strong influence of agitation on the stress and composition of the deposit, and the fact that the solution could be operated with alloy anodes. (auth)

5067 (SGAE-2034) DYNAMICS OF SIMPLE FLUIDS. Eder, O. J. (Oesterreichische Studiengesellschaft fuer Atomenergie G. M. B. H., Seibersdorf. Physik-Institut). Sep 1972. 27p. (In German). (CONF-720969-1). Dep. NTIS (U. S. Sales Only).

5068 (SGAE-BL-55/73) MODIFICATION OF GENETIC MATERIALS OF THE CELL BY CHEMICAL COMPOUNDS WHICH REPRESENT ENVIRONMENTAL CONTAMINATION. Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf. Institut fuer Biologie). Jan 1973. 23p. (In German). (SGAE-2084). Dep. NTIS (U. S. Sales Only) $3.00.

5069 (SGAE-PH-136/73) GAS SCATTERING AS A LIMIT TO PARTIAL PRESSURE SENSITIVITY. Ruedenauer, F. G. (Oesterrichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf. Physik-Institut). Jan 1973. 16p. (CONF-711045-2; SGAE-2080). Dep. NTIS (U. S. Sales Only) $3.00.

From 5th international vacuum congress; Boston, Massachusetts, USA (11 Oct 1971).

5070 (SLA-73-7) PRECISION GRAPHICS AT SANDIA LABORATORIES, ALBUQUERQUE, NEW MEXICO. Carli, G.; Brane, J. P.; Oliver, D. A.; Urish, G. R. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 50p. Dep. NTIS $4.50.

5071 (SLA-73-338) CALCULATION OF SPECTRA FROM EMP-TYPE WAVEFORMS. Vittitoe, C. N. (Sandia Labs., Albuquerque, N. Mex.). Mar 1973. 34p. Dep. NTIS $3.75.

Electromagnetic pulses typically have a large amplitude over a very small time interval. As a result, a substantial portion of their spectra is at high frequencies. Lower-frequency contributions then occur for times several orders of magnitude larger. A method is presented for calculating the Fourier transform of such pulses. This procedure may improve the high-frequency representation in cases where $|F(\omega)| \sim \omega^n$ with $n \gtrsim -4$ at high frequencies. Limitations are discussed, together with those of the usual transform methods. Two examples are used as illustrations. (auth)

5072 (TID-4579-R7) SERIAL TITLES CITED IN NUCLEAR SCIENCE ABSTRACTS. (Technical Information Center (AEC), Oak Ridge, Tenn.). Mar 1973. 472p. Dep. NTIS $10.60.

5073 (UCID-16240) SIMPLE SENSOR AND RECORDER FOR FAST CURRENT PULSES. Hsieh, E. J.; Vindelov, K. E.; Condas, G. A. (California Univ., Livermore. Lawrence Livermore Lab.). 29 Mar 1973. Contract W-7405-eng-48. 10p. Dep. NTIS $3.00.

5074 (UCRL-51336) FIRST ANNUAL REPORT, DOT-CIAP PROGRAM. MacCracken, M. C. (California Univ., Livermore. Lawrence Livermore Lab). 13 Feb 1973. Contract W-7405-eng-48. 220p. Dep. NTIS $7.60.

5075 (UR-49-1460) POSSIBLE ROLE OF APATITE CRYSTALS IN THE ORIGINS OF LIFE. Neuman, W. F. (Rochester Univ., N. Y.). 1971. 8p. (CONF-711152-1). Dep. NTIS $3.00.

From 28th meeting on the American Institute of Oral Biology; Palm Springs, California, USA (5 Nov 1971).

5076 (UR-49-1463) SKELETON AS A CHEMICAL WAREHOUSE. Neuman, W. F. (Rochester Univ., N. Y.). 1971. 6p. (CONF-711152-2). Dep. NTIS $3.00.

From 28th meeting on the American Institute of Oral Biology; Palm Springs, California, USA (5 Nov 1971).

5077 (UR-3490-170) NONIONIZING RADIANT ENERGY IN THE HEALING ARTS--PRODUCT EMISSION STANDARDS AND PERSONNEL EXPOSURE STANDARDS. Michaelson, S. M.; Houk, W. M. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). 1972. 10p. (CONF-721204-3). Dep. NTIS $3.00.

From seventh midyear topical symposium on health physics in the healing arts; San Juan, Puerto Rico, USA (11 Dec 1972).

5078 (UR-3490-199) NATURE OF THE MEMBRANE SITES CONTROLLING ANION PERMEABILITY OF HUMAN RED BLOOD CELLS AS DETERMINED BY STUDIES WITH DISULFONIC STILBENE DERIVATIVES. Cabantchik, Z. I.; Rothstein, A. (Rochester Univ., N. Y. Dept. of Radiation Biology and Biophysics). [nd]. 39p. Dep. NTIS $4.00.

5079 SUBSTITUTIONAL-INTERSTITIAL SOLUTE-ATOM INTERACTIONS IN Ta-Re-N AND Ta-Re-O ALLOYS. Sagues, A. A. Cleveland; Case Western Reserve Univ. (1972). 152p. University Microfilms Order No. 73-6336.

Thesis (Ph.D.).

Internal friction experiments at low and high frequency have been performed on tantalum-nitrogen, tantalum-rhenium-nitrogen and tantalum-rhenium-oxygen alloys. Computer analysis of the tantalum-nitrogen-rhenium results discloses the presence of three single relaxation time components in the relaxation spectrum. Experiments involving solute concentration variations and study of the spectrum at different temperatures show that one of the components (#1) can be ascribed to the nitrogen Snoek relaxation in tantalum, while the remaining two can be explained as caused by ReN clusters (#2) and Re_2N clusters (#3). Moreover, values for the binding enthalpies of the clusters are obtained. Concentration dependence experiments performed in the tantalum-rhenium-oxygen alloys indicate the presence of an undetermined number of clusters with compositions of the type Re_xO, with x unknown as yet. Orientation dependence experiments were performed in both sets of ternary alloys. In both cases the orientation dependence of the relaxation strength of the entire spectrum is identical to that expected for a pure Snoek relaxation. This result has been interpreted as an indication of tetragonal ⟨100⟩ or orthorhombic ⟨100⟩ symmetry for the substitutional-interstitial clusters present. Models consistent with this behavior have been proposed. From separate experiments on high-purity tantalum a value for the binding energy between interstitials (probably mainly nitrogen) and dislocation sites was obtained. (Diss. Abstr. Int., B)

5080 INTERNATIONAL MEASUREMENT CONFEDERATION. II. Proceedings of the 5th IMEKO Symposium on Photon Detectors Held in Varna, Bulgaria, May 24-26, 1971. Schanda, J. (ed.). Budapest; IMEKO Secretariat (1971). 235p. (In German and English). (CONF-710564-(Vol.2)).

From 5th IMEKO symposium on photon-detectors; Varna, Bulgaria (24 May 1971).

Twenty-eight papers were presented at the conference. A separate abstract was prepared for each of 4 papers. The remaining 24 papers were not within the scope of NSA. (WHK)

For abstracts of individual papers see: 2662 through 2665.

5081 INTERNATIONAL MEASUREMENT CONFEDERATION. I. Proceedings of the 5th IMEKO Symposium on Photon Detectors Held in Varna, Bulgaria, May 24-26, 1971. Schanda, J. (ed.). Budapest; IMEKO Secretariat (1971). 220p. (In German and English). (CONF-710564-(Vol.1)).

From 5th IMEKO symposium on photon-detectors; Varna, Bulgaria (24 May 1971).

Ten papers are presented on the external photoeffect and its application and the receiving of image information. (WHK)

5082 SMALL-ANGLE X-RAY SCATTERING FROM POLYETHYLENE BEFORE AND AFTER IRRADIATION. Gupta, V. D. (Univ. of Lucknow, India); Deopura, B. L. Indian J. Pure Appl. Phys.; 10: No. 9, 657-662(Sep 1972).

Small-angle x-ray scattering from linear and annealed polyethylene sample is investigated and the results are reported. The scattering curve is analyzed on the basis of a two-phase electron density parallel-layer model. The theoretical correlation function is obtained and compared with the experimental one. The model parameters are reported. To test the validity of the two-phase model, scattering from an irradiated sample is also studied. (53 references) (auth)

5083 THERMAL CONDUCTIVITY OF CARBIDES OF GROUP IV TRANSITION METALS AT HIGH TEMPERATURES. Dzhafarov, E. O.; Golikova, O. A.; Stil'bans, L. S. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 123-126 (1972). (In Russian).

The thermal conductivity, and thermal emf of Zr and Ti carbides were measured by a simplified method over a temperature range of 100 to 1700°K. The data showed that TiC and ZrC maintained large values of χ_p (thermal conductivity) up to the highest temperatures and, therefore, have potential as prospective materials in thermoelements. (KSW)

5084 EFFECT OF ANNEALING TEMPERATURE ON SOME PROPERTIES OF MOLYBDENUM AND TUNGSTEN FIBRES. Sebo, P.; Ivan, J.; Taborsky, L.; Havalda, A. Kovove Mater.; 10: No. 5, 423-431(1972). (In Slovak).

Molybdenum and W wires, having 0.08, 0.1, 0.15, 0.20, 0.50, and 1 mm diameters (compositions are given) were annealed in a vacuum at 400 to 1200°C for 2.5 h. Electrical conductivity and mechanical strength were measured (after cooling) as a function of annealing temperature and wire thickness. The structure was studied metallographically. A plot is shown of the dependence of the strength of W wires on their diameter, the thicker wires exhibiting lower strengths. The W wires are shown to possess higher electrical resistances than the Mo wires. The optimum diameters for composite applications are determined as 0.1 to 0.2 mm. (Metals Abstr.)

5085 SYSTEM $K_2O-B_2O_3-WO_3$. Bergman, A. G.; Volkov, V. L.; Mal'tsev, V. T. (Rostov Construction Engineering Inst., USSR). Zh. Neorg. Khim.; 18: No. 4, 1087-1091(Apr 1973). (In Russian).

A triangular phase equilibrium diagram was constructed for the system $K_2O-B_2O_3-WO_3$, using data from thermal and x-ray studies. A ternary congruently melting compound with the formula $3K_2O \cdot 3B_2O_3 \cdot 4WO_3$ was identified. An area of stratification was noted in the $K_2O \cdot WO_3$ field. The thermodynamic processes occurring in this ternary system are discussed. (KSW)

COLLECTIONS OF USAEC REPORTS
IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atomica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atomica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd., Chalk River
Ontario, McMaster University
Ottawa, National Research Council
Vancouver, B.C., University of British Columbia Library

DENMARK
Risö, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Leopoldshafen, Zentralstelle für Atomkernenergie Dokumentation
Munchen, Technischen Universitat

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Instituto

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Holland, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PERU
Lima, Junta de Control de Energia Atómica

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energia Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment
London, National Reference Library

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
National Lending Library for Science and Technology, Boston Spa, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF
PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U S GOVERNMENT PRINTING OFFICE

U.S.MAIL

Technical Books & Monographs

Sponsored by the United States Atomic Energy Commission

1973 Catalog

This bibliography of publications sponsored by the U. S. Atomic Energy Commission over the past 25 years provides access to a large body of basic knowledge generated by the AEC research and development programs. The catalog gives for most publications a brief descriptive statement, lists or describes the contents, and indicates the availability. Included in the more than 350 publications are titles from several AEC monograph series, prepared for the AEC by the American Chemical Society, American Industrial Hygiene Association, American Institute of Biological Sciences, American Nuclear Society, and American Society for Metals. In addition to the technical books and monographs, a section at the end of each subject category lists recent symposium proceedings published as AEC project reports. Title, author, and series indexes are provided. 147 pages, 5½ by 8½ inches.

Available as TID-4582-R9 without charge from

USAEC Technical Information Center
P. O. Box 62
Oak Ridge, Tennessee 37830

SUBJECT CATEGORIES

- *General Reference*
- *Biology and Medicine*
- *Chemistry*
- *Computers*
- *Energy*
- *Engineering and Instrumentation*
- *Environment*
- *Health Physics*
- *Isotope Separation*
- *Metallurgy*
- *Physics*
- *Reactors*
- *Vacuum Technology*